Devoted to
TEXTILE
CHEMISTRY
BLEACHING
DYEING
PRINTING
FINISHING

OCTOBER 6, 1947
VOLUME 36, No. 20

AMERICAN DYESTUFF REPORTER

OCT 9
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Pontamine*

DIAZO RED SCARLET NN CONC.

This developed color produces bright scarlet shades on rayons. It is especially useful as a ground color for discharge prints on rayon dress goods. Fast to dry cleaning and perspiration. Easily applied . . . penetrates and levels well.

E. I. du Pont de Nemours & Co. (Inc.), Dyestuffs Div., Wilmington 98, Del.

*REG. U. S. PAT. OFF.

Du Pont Dyestuffs
DU PONT
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

OFFICIAL PUBLICATION
of the
PROCEEDINGS
AMERICAN ASSOCIATION
OF TEXTILE CHEMISTS
AND COLORISTS

CHEMICAL
RESEARCH
for
Fabric
Perfection

*Reg. U. S. Pat. Off.

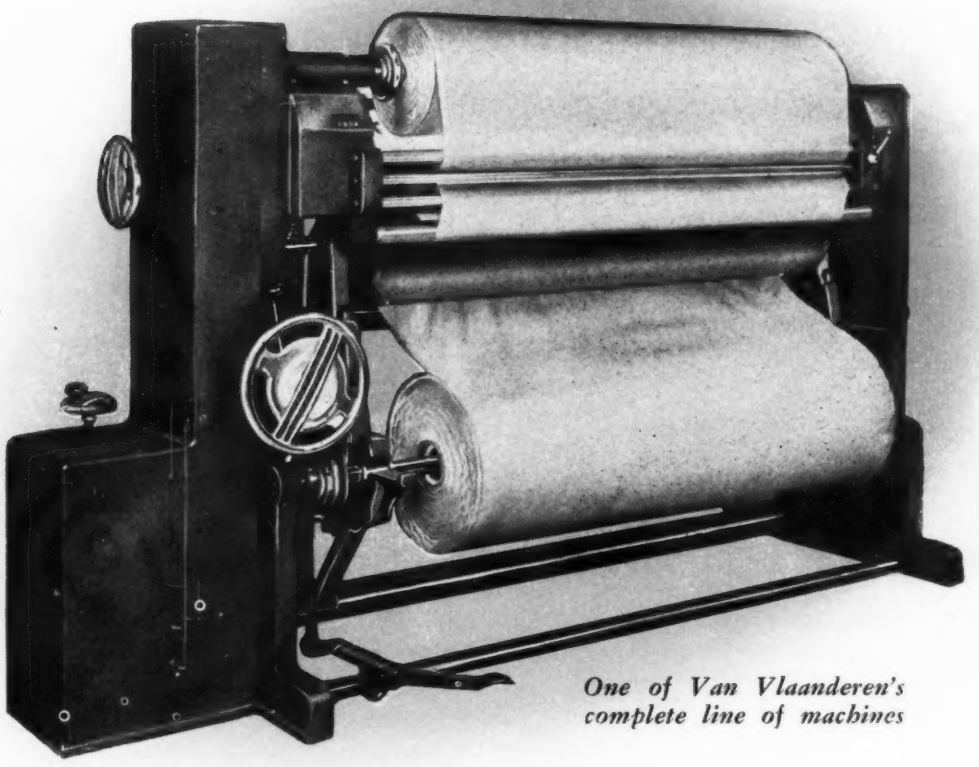
FORMASET*

Under the name of Formaset we are marketing a series of synthetic resin finishes for textiles. Several new types developed as a result of Warwick's research have been added. Each Formaset has its particular advantages designed to solve specific finishing problems. Warwick technical advisors will gladly work with you in determining the correct Formaset for your needs.

WARWICK CHEMICAL COMPANY

A Division of Sun Chemical Corporation

580 FIFTH AVENUE, NEW YORK 19, N. Y.



One of Van Vlaanderen's complete line of machines

TIME TESTED, NOW EVEN BETTER

This Van Vlaanderen Tubing Machine has done excellent work through the war years. Now it has been improved to process up to 250 yards a minute and to take larger diameter rolls on tubes.

Operation of the machine is through mechanical controls within easy reach of the operator. Cloth speed is constant and measuring is accurate and dependable. Ball bearings are used throughout. Motor and 1-3 variable speed drive. Lubricated parts are sealed in oil.

Write for full information on this machine

VAN VLAANDEREN MACHINE COMPANY

370 Straight St., Paterson 3, New Jersey • Cable Address: VLAANDEREN, PATERSONNJ, U.S.A.

World's largest manufacturer of machines for processing modern fabrics

UNITED STATES RUBBER COMPANY

SERVING THROUGH SCIENCE

Announces

Kandar*

a new permanent finish for improving the appearance and hand of cotton and rayon

Here comes finer quality for every cotton and rayon textile.

Kandar puts fullness and crispness into the fabric to stay . . . makes the hand more pleasant . . . increases the quality at low cost.

Fabrics finished with Kandar will have sharper patterns, brighter colors and a smoother finish. Linting will be reduced. Tensile strength will be increased.

Kandar is a permanent finish which can be applied with no additional equipment. It requires no curing. Has no objectionable odors.

It is readily compatible with other fabric finishes.

Developed in the Laboratories of United States Rubber Company, Kandar has already demonstrated its ability to bring revolutionary improvement to cottons and rayons.

We welcome inquiries. Sample quantities will be supplied upon request. Tests will be conducted in your mill.

NAUGATUCK CHEMICAL

Division of United States Rubber Company

NAUGATUCK, CONNECTICUT

BRANCHES: AKRON • BOSTON • DETROIT • LOS ANGELES • PHILADELPHIA • NEW YORK

*Reg. U. S. Pat. Off.

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for REDS of radiant beauty

AMANIL NAPTHOLS ★ FAST COLOR SALTS OR BASES ★ STABILOL

Ideal combinations for perfect coloring throughout the red range and into gold . . . everything you need for complete satisfaction in Napthol dyeing and printing. » » » Let us demonstrate the A.A.P. way to best results with the Napthol process; just call our nearest office, and an A.A.P. technician will gladly visit your plant.

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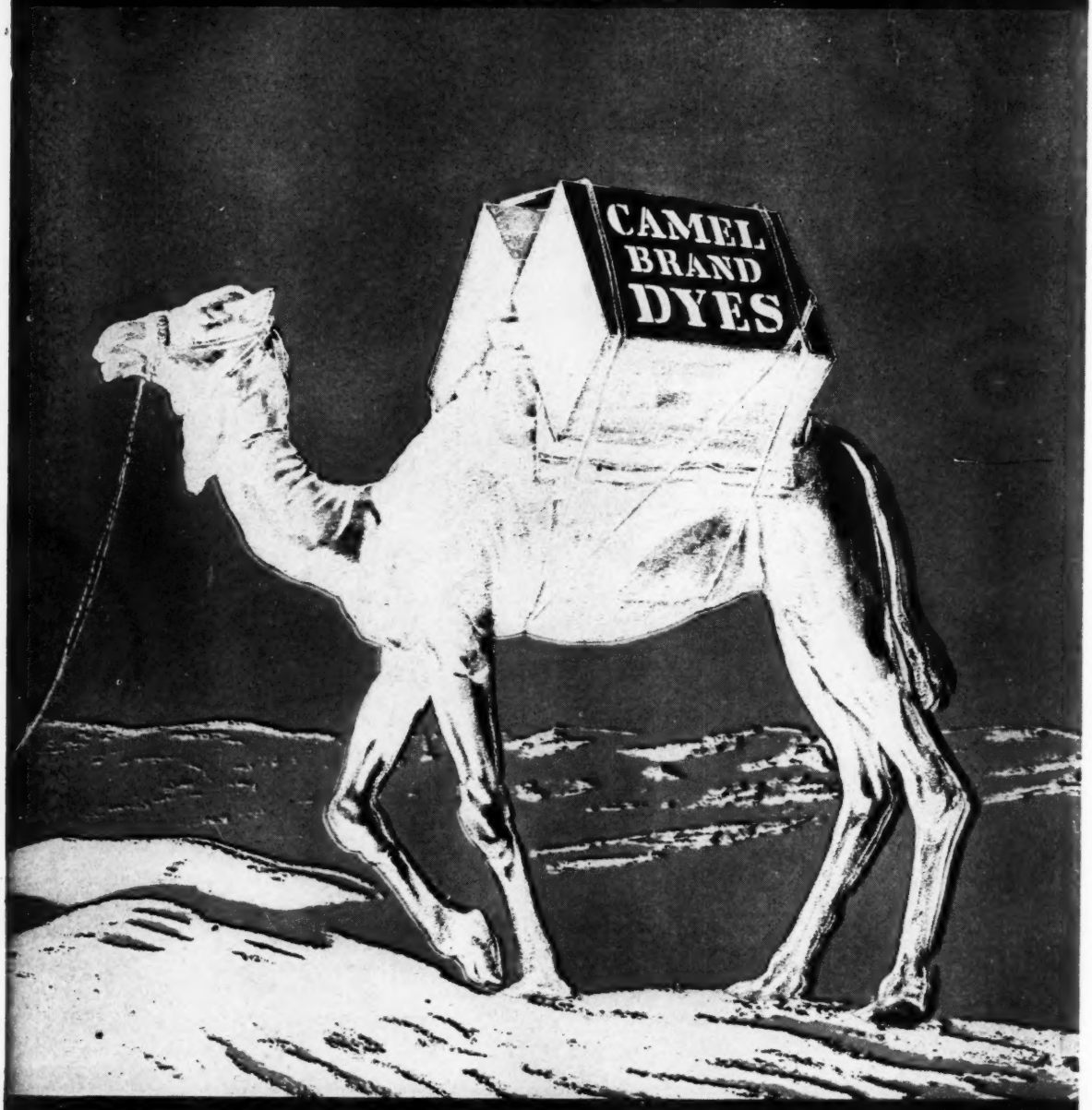
Branches: Boston, Mass.—Providence, R. I.—Philadelphia, Pa.—Charlotte, N. C.—Chicago, Ill.—Los Angeles, Cal.—Chattanooga, Tenn.—Dominion Anilines & Chemicals Ltd.—Toronto, Canada—Montreal, Canada.

QUALITY DYESTUFFS

SINCE 1878



JOHN CAMPBELL & COMPANY, INC.

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PHILADELPHIA: BROAD AND SPRING GARDEN STS.

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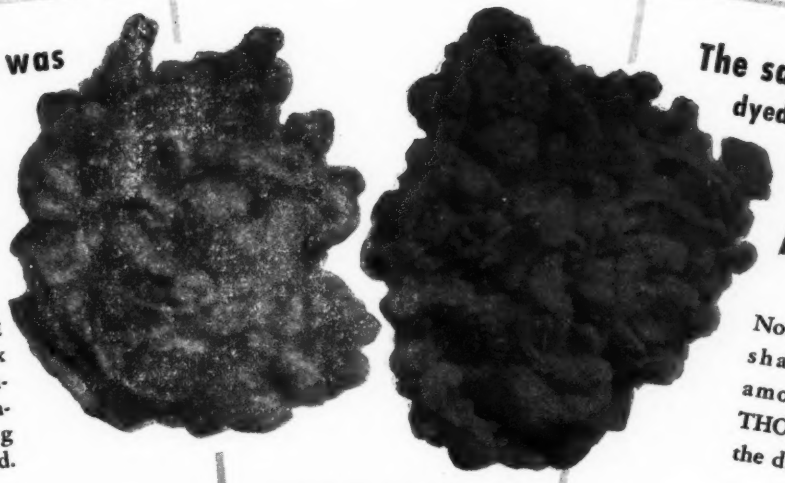
BOSTON EAST CLEVELAND, OHIO ATLANTA, GA.

TIPPY WOOL ?

This wool was dyed in the ordinary way

An ACID BLUE (Color Index No. 208) considered an uneven dyeing color, was used.



The same wool— dyed with the same color, but with the aid of ANTHOMINE

Note the uniform shade. A small amount of ANTHOMINE made the difference.

TRY ANTHOMINE !

(PATENT APPLIED FOR)

TO ELIMINATE UNEVEN DYEINGS

. . . QUICKER AND BETTER EXHAUSTION OF THE DYEBATH

. . . A SOFTER, MORE PLEASING "HAND"

. . . SUBSTANTIAL INCREASE IN COLOR YIELD

. . . NO SACRIFICE OF BRIGHTNESS OR FASTNESS

. . . PROCESSING TIME REDUCED

Although it has only recently been released for general sale, ANTHOMINE has been used and tested by many mills for more than a year. Colors and wool with tendencies toward uneven and tippy dyeing were especially selected for testing.

The results of actual mill use of ANTHOMINE in dyeing stock, yarn, or piece goods confirmed the hundreds of tests made in our laboratories.

Thus, ANTHOMINE is now offered to the trade as a tried and tested solution to the tippy wool dyeing problem with an assurance born of complete success in dyehouse.

Write for Technical Service Bulletin No. 203.100.1

Arkansas Co. INC.

Manufacturers of Industrial Chemicals for Over 40 Years

NEWARK, NEW JERSEY

Score at the FINISH!

Whether the goal is sales or sports . . . it's the *finish* that counts. Hosiery, and other textile products . . . to have *sales appeal* must have *eye appeal*.

For all your textile chemical needs . . . detergents, wetting agents, water repellents, cationic softeners, etc., you can depend on Fancourt materials and "know-how" to help you cash in *at the finish*.

W. F. FANCOURT & CO.

PHILADELPHIA, PA.

In the South, Howard A. Virkler, Greensboro, N. C.

Solving Finishing Problems Since 1904

Santomerse No. 1

for Penetration • Wetting out Scouring (cleansing)

Santomerse No. 1 finds wide appeal in the textile industry, as shown in the table of applications for cotton and linen processing. Santomerse No. 1 not only possesses the requirements for penetration, wetting out and scouring (cleansing), but, in addition, is stable to acid, alkali and hard water; forms soluble metallic salts, rinses quickly without insoluble deposit. The protective surface action exerted by Santomerse No. 1 makes it a desirable additive to dye baths, because of its leveling effect.

cotton and linen processing

APPLICATION	EFFECT
RAW STOCK—	
Carding	Reduce fly — wetting
Dyeing	Leveling, wetting
Kier boiling	Wetting, dispersing, scouring
Oiling	Wetting, ease removal
Scouring	Cleansing
WAYS—	
Bleaching	Wetting to increase uniformity
Dyeing	Leveling, protective colloid
Enzyme desizing	Wetting, dispersing
Scouring	Cleaning
Sizes	Penetrant
Slashing	Wetting, ease removal
Wetting out	Wetting, increase processing quality and speed
WOVEN GOODS—	
Absorbency	Improvement for towels, face cloths, mops
Dyeing	Wetting, leveling
Kier boiling	Wetting, dispersing, scouring
Flame proofing	Wetting, penetrant
Mercerizing	Wetting
Sanforizing	Wetting
Shrinksetting	Wetting
PACKAGE AND SKEIN GOODS—	
Conditioning	Wetting
Dyeing	Wetting, leveling
Scouring	Cleansing
Wetting out	Wetting
Wet twisting	Wetting

SANTOMERSE No. 1 IS SIMILARLY USEFUL IN PROCESSING OPERATIONS FOR RAYON, SILK, NYLON AND WOOL

For further details on the application of Santomerse No. 1 to the textile field, send for your copy of Monsanto's new Application Data Bulletin No. P-118. Contact the nearest Monsanto District Sales Office, or write to MONSANTO CHEMICAL COMPANY, Phosphate Division, 1700 South Second Street, St. Louis 4, Missouri. District Sales Offices: New York, Philadelphia, Chicago, Boston, Detroit, Cleveland, Cincinnati, Charlotte, Birmingham, Los Angeles, San Francisco, Seattle. In Canada: Monsanto (Canada) Limited, Montreal. *Santomerse: Reg. U. S. Pat. Off.*

MONSANTO
CHEMICALS AND PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

3 portraits

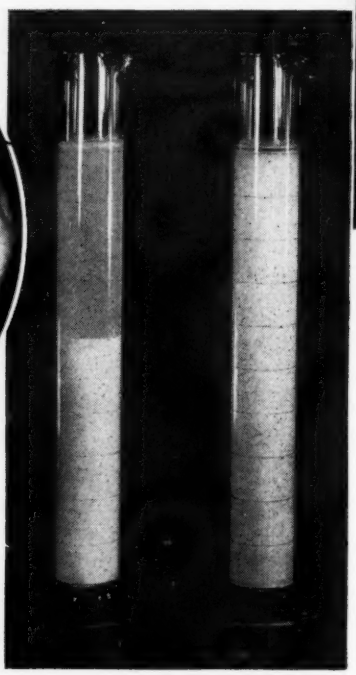
of a dispersing agent at work

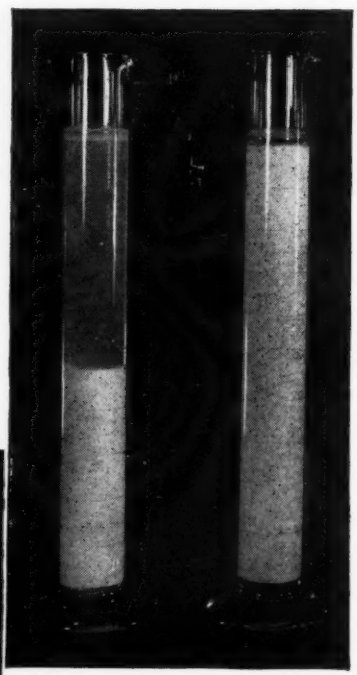
—of interest to finishers concerned with the delustering of rayon or the filling of cotton with pigments. Dispersion of pigments is only one of many applications of Calgon* which are important to the textile industry. You will find a detailed account of its properties and uses in the booklet "Calgon Data for the Textile Chemist."

We will be glad to send you a copy.

Poured clay slurry

(60% solid)
The *same slurry* except that Calgon (3/10 of 1%) has been added to the one at the right.





Titanium oxide slurry

(15%)
—after standing 23 hours. Calgon (8/10 of 1%) has been added to the one at the right.

Zinc oxide slurry

(15%)
—after standing 23 hours. Calgon (8/10 of 1%) has been added to the one at the right.

* *T. M. Reg. U. S. Pat. Off.*

HAGAN HALL BUROMIN CALGON

calgon, inc.

A SUBSIDIARY OF HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PA.

INDANTHRENE
UNSURPASSED
IN FASTNESS
TO SUNLIGHT
AND WASHING
GENERAL DYESTUFF CORPORATION

"Fashion may be fickle

but I'm not"

Like every woman, she always knows and loves one constant quality amid the shifts and changes of fashion—and that is the beauty of the fabric itself. And proper processing has *so much* to do with a fabric's quality of eye-appeal.

That explains why more and more of America's leading mills, converters, finishers and dyers have turned to Colgate-Palmolive-Peet for high-quality wetting, fulling, scouring and dispersing agents.

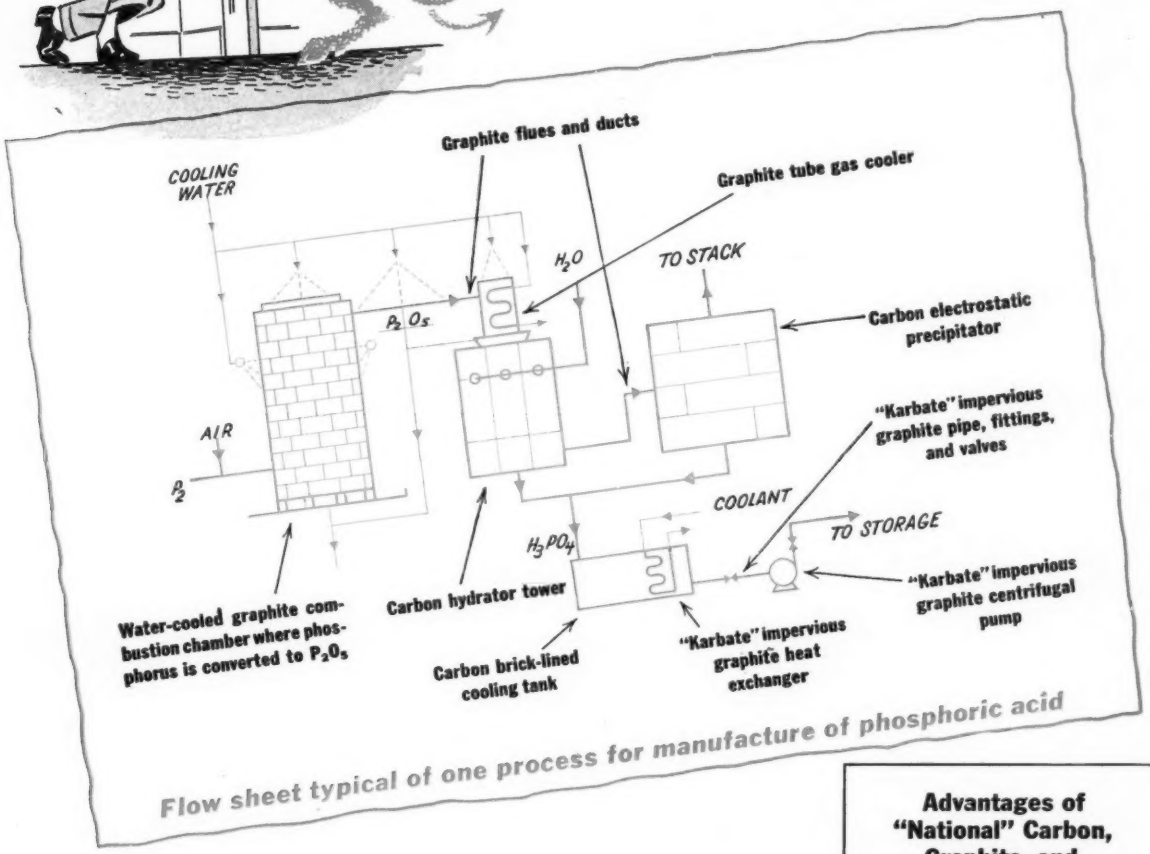
Remember, there is a C.P.P. soap or synthetic detergent for every type of fabric—for every processing problem. Ask your Colgate-Palmolive-Peet representative for complete details. Or, write to Industrial Department, Colgate-Palmolive-Peet Company.

COLGATE FORMULA 25
COLGATE WHITE SOAP FLAKES
ARCTIC CRYSTAL FLAKES
ARCTIC SYNTEX A, T AND M
COLGATE FORMULA 10

Colgate-Palmolive-Peet Company

JERSEY CITY 2, N. J. • ATLANTA 3, GA. • CHICAGO 11, ILL. • KANSAS CITY 3, KANS. • BERKELEY 2, CALIF.

...in manufacturing phosphoric acid...with Carbon, Graphite, and "Karbate" Impervious Graphite



Flow sheet typical of one process for manufacture of phosphoric acid

CARBON, Graphite, and "Karbate" materials are ideal for the construction of complete systems for the manufacture of phosphoric acid and related compounds. They are unattacked by phosphorus, its oxides and acids, or by those contaminants normally encountered in the manufacture of these products.

Graphite material, because of its high thermal conductivity, is required for combustion chambers and gas coolers; but either carbon or graphite is suitable for hydrators and precipitators. Chamber and hydrator construction may be either vertical or horizontal, completely of graphite and carbon, or graphite and carbon-lined steel, depending upon individual design considerations.

Advantages of "National" Carbon, Graphite, and "Karbate" materials

- No melting point
- Immune to thermal shock
- No metallic contamination of product
- Light weight with adequate strength
- Easy to machine and install

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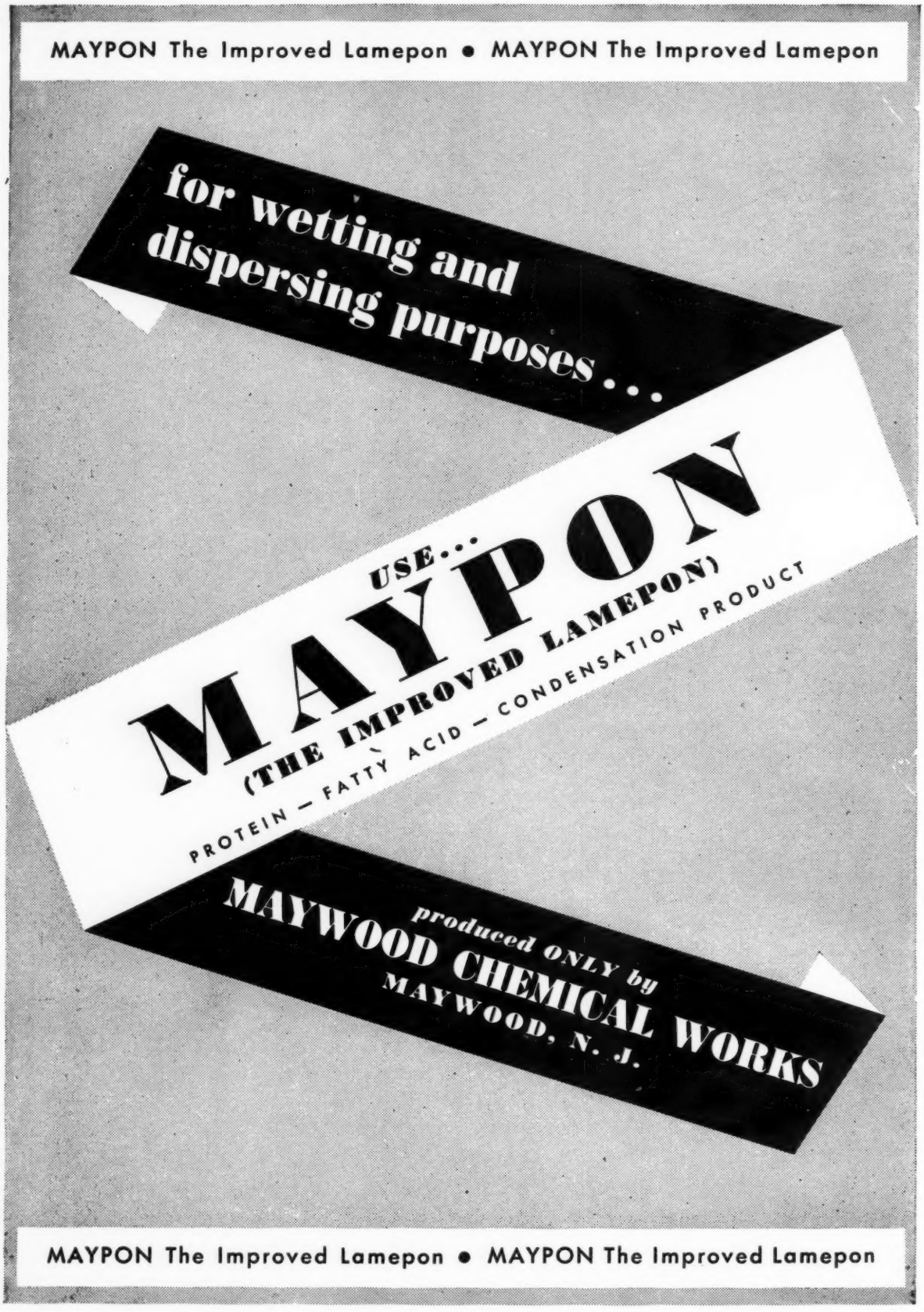
Unit of Union Carbide and Carbon Corporation

UCC

30 East 42nd Street, New York 17, N. Y.

Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

The terms "Karbate" and "National" are registered trade-marks of National Carbon Company, Inc.


MAYPON The Improved Lamepon • MAYPON The Improved Lamepon
for wetting and dispersing purposes . . .
USE . . .
MAYPON
(THE IMPROVED LAMEPON)
PROTEIN — FATTY ACID — CONDENSATION PRODUCT
produced ONLY by
MAYWOOD CHEMICAL WORKS
MAYWOOD, N. J.
MAYPON The Improved Lamepon • MAYPON The Improved Lamepon

She Insists on *Better... Lasting Snag Resistance*

SHE wants her nylons to have a pleasing, mellow hand and a good body, but she'll react most favorably of all to better snag resistance and a finish that doesn't vanish with the first few washings! That's why so many mills prefer **ETERNALURE** for finishing their nylons.

This water-dispersed synthetic resin finish will put these values into your nylon hose and increase their sales appeal immeasurably. And at the same time it will simplify and improve your finishing operations.

Used in paddle or rotary machines, just as you apply ordinary finishes, **ETERNALURE** exhausts out of the bath onto the hose. Pull threads are kept at a minimum on treated hose, while pairing is speeded, particularly on 15, 20 and 30 denier. There's no building up of deposits on the forms . . . and hose don't stick to them!

Want a Demonstration?

Eternalure

RESIN FINISH FOR NYLONS

Onyx Oil & Chemical Company

JERSEY CITY 2, N. J.

CHICAGO • PROVIDENCE • CHARLOTTE • ATLANTA • LOS ANGELES

In Canada: Onyx Oil & Chemical Co., Ltd., Montreal, Toronto, St. Johns, Que.
For Export: Onyx International, Jersey City 2, N. J.

onyx RESIN FINISHES FOR HOSIERY

Efficient, uniform drying in moderate capacities

PROCTOR TRUCK DRYER for Cakes or Skeins

Accepted for years as a highly efficient dryer for rayon skeins, the Proctor truck dryer has been adapted recently for drying processed rayon cakes. It is especially applicable for capacities ranging from 400 to 2,000 pounds of cakes or skeins per day. With these dryers in operation, it is possible for the throwing mill to dry cakes and skeins interchangeably in the same machine—or in larger machines with two or more trucks—at the same time, for there is a difference in the way in which trucks must be loaded for each. Skeins or cakes are hung on poles which rest on supports along the sides of the truck, as can be seen from the photograph. Poles are spaced in a staggered manner when the truck is being used for cakes. When it is to be used for skeins, intermediate pole supports are not used, and the top and middle supports are reversed, providing the proper spacing for skeins. The smaller dryers accommodate one or two trucks at a time and may be provided with doors at one end or both ends, depending upon individual requirements. The machine has a proven record for uniformity of drying, high efficiency, low steam consumption and low power requirements. It is proving to be the answer to the need of the throwing mill with a moderate output of either skeins or cakes. You'll find it well worth your while to investigate the details of this modern Proctor equipment. Write today.

PROCTOR & SCHWARTZ, INC.

PHILADELPHIA 20, PA.

DIISOBUTYL KETONE

Ketones

ETHYL BUTYL KETONE

Available in commercial quantities —to give you formulating freedom in the manufacture of lacquers and synthetic resin coatings.

	Diisobutyl Ketone	Ethyl Butyl Ketone
FORMULA	$C_4H_9COC_4H_9$	$C_4H_9COC_2H_5$
Boiling Point at 760 mm. Hg	168.1°C.	147.8°C.
Toluene Dilution Ratio at 20°C.	1.5	2.6
½ sec. R.S. Nitrocellulose Viscosity, 18% "Vinylite" resin VYHH Solution	Gel Structure	112 cps
Evaporation Time (Butyl Acetate = 8 hr.)	44 hr.	14 hr.
Weight per gal. at 20°C.	6.73 lb.	6.8 lb.
Specific Gravity at 20/20°C.	0.8089	0.8197

DIISOBUTYL KETONE

Dispersant—Best all around resin dispersant available for making organosols based on VINYLITE resin VYNV. Makes possible semi-hard and hard metal coatings containing little or no plasticizer, and aids in the preparation of highly plasticized coatings for cloth and paper.

Solvent—Retards premature evaporation in brushing lacquers, and reduces blushing in air-dried lacquers. Gives better flow-out and gloss to baked finishes.

ETHYL BUTYL KETONE

Dispersant—Produces fluid organosols having good viscosity stability on aging. Permits high solids content and makes good, clear films without checking ("mud cracking").

Solvent—Good solvent in both air-dried and baked finishes based on nitrocellulose or vinyl resins. Less active in lifting undercoats.

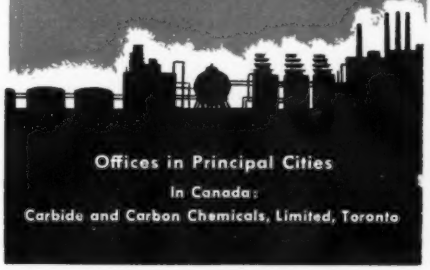
Intermediates—When condensed with amines and other chemical groups capable of reacting with the carbonyl group, these ketones give compounds of interest as inhibitors, rubber accelerators, dyes, pharmaceuticals, and insecticides. Ask for technical literature on diisobutyl ketone F-6934, and ethyl butyl ketone F-6918 —when writing please address Dept. A-10.

The word "Vinylite" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

CARBIDE and CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York 17, N. Y.

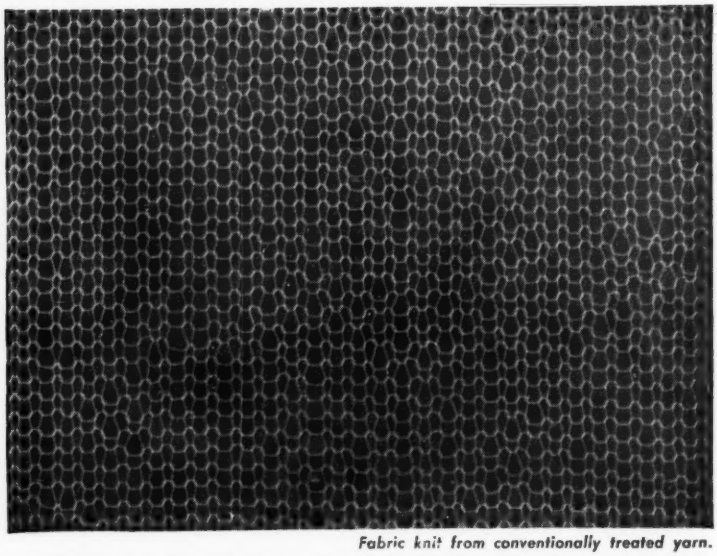


Offices in Principal Cities

In Canada:

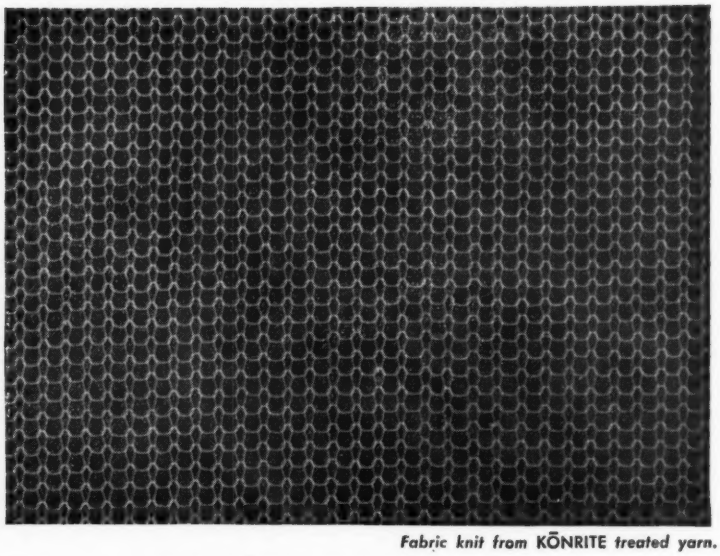
Carbide and Carbon Chemicals, Limited, Toronto

Is your stitch like this



Fabric knit from conventionally treated yarn.

or like this



Fabric knit from KŌNRITE *treated yarn.*

For the treatment of yarns for truly fine hosiery, Nopco presents KŌNRITE, a new and unique nylon coning oil. In Coning, Knitting, Seaming, KŌNRITE offers you:

OUTSTANDING RESULTS...

- ... ***in Coning*** — produces cones of proper density, practically eliminating overlaps, crossovers and underwinds
- ... increases cone production
- ... ***in Knitting*** — minimizes stripping of size — reduces pressoffs
- ... gives clear perfect stitch formation
- ... ***in Seaming*** — reduces roll ... its strong defense against curling is a major factor in greatly increased hosiery production

OUTSTANDING ADVANTAGES...

- ... Controlled viscosity, assuring even distribution of oil on yarn
- ... New stitches firmly cemented through rapid drying action
- ... Prevention of softening in lagged yarn and fabric

For full information on KŌNRITE, *please write today.*

NOPCO CHEMICAL COMPANY, Harrison, N. J.

Formerly National Oil Products Company

BRANCHES: BOSTON • CHICAGO • CEDARTOWN, GA. • RICHMOND, CALIF.

EVOLVED THROUGH RESEARCH NOPCO

Kōnrite The Outstanding Nylon Coning Oil

HEYDEN chemicals serve the nation's industries

TEXTILES AND LEATHER

FORMIC ACID
FOR

TEXTILES	LEATHER
Dyeing of acid colors	Dyeing with acid colors
Sour to prevent yellowing	Deliming and pickling
After-treatment of sulfur colors	Swelling and soaking
Wool treatment in mothproofing	Disinfection
Acid wash after dyeing or resin treatment	Mold-prevention
	Chrome and vegetable tans

SODIUM FORMATE
FOR

TEXTILES	LEATHER
Mordant in dyeing or printing	Chrome tanning for "full" and "round" feel
Humectant	

FORMALDEHYDE, SOLUTION U.S.P.
FOR

TEXTILES	LEATHER
Wool stabilization	Formaldehyde tanning
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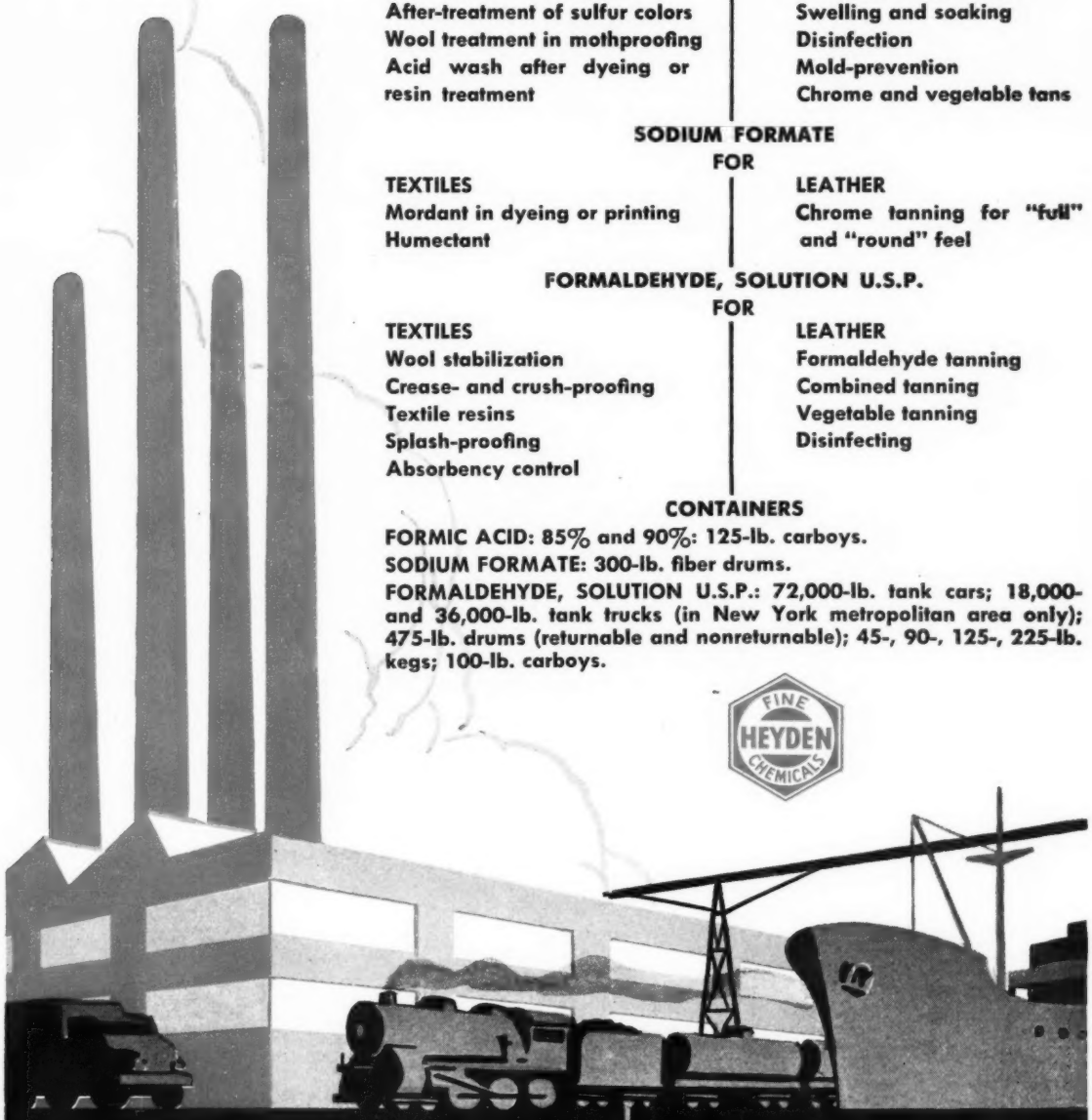
Textile resins	Vegetable tanning
Splash-proofing	Disinfecting
Absorbency control	

CONTAINERS

FORMIC ACID: 85% and 90%: 125-lb. carboys.
SODIUM FORMATE: 300-lb. fiber drums.
FORMALDEHYDE, SOLUTION U.S.P.: 72,000-lb. tank cars; 18,000- and 36,000-lb. tank trucks (in New York metropolitan area only); 475-lb. drums (returnable and nonreturnable); 45-, 90-, 125-, 225-lb. kegs; 100-lb. carboys.

FINE HEYDEN CHEMICALS



HEYDEN CHEMICAL CORPORATION
393 SEVENTH AVENUE, NEW YORK 1, N. Y.
CHICAGO OFFICE, 20 North Wacker Drive
PHILADELPHIA OFFICE, 1700 Walnut Street

Benzaldehyde • Benzoates • Benzoic Acid • Benzyl Chloride
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Formates • Formaldehyde • Formic Acid • Glycerophosphates • Medicinal Guaiacols • Hexamethylenetetramine
M.D.A. • Paraformaldehyde • Parahydroxybenzoates
Penicillin • Pentaerythritols • Salicylates

NYANZA

ANILINE & ALIZARINE COLORS

•

TEXTILE CHEMICALS

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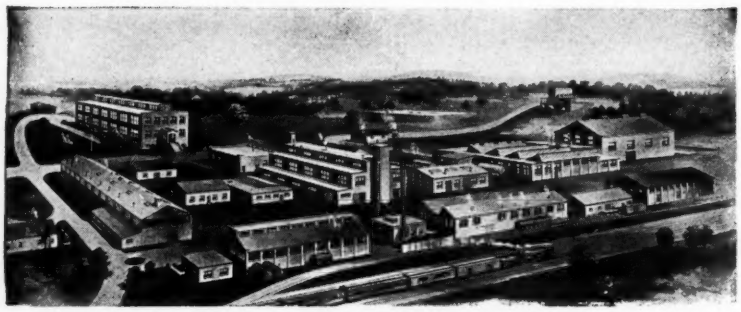
FINISHING MATERIALS

FOR

WOOL—COTTON—RAYON—ACETATE

AND MIXED FIBERS



FACTORY AT ASHLAND, MASSACHUSETTS

NYANZA COLOR & CHEMICAL COMPANY, Inc.

215 WATER STREET NEW YORK CITY

FACTORIES:

CHEMICAL MANUFACTURING CO., ASHLAND, MASS. • NEW BRUNSWICK CHEMICAL CO., NEWARK, N J.

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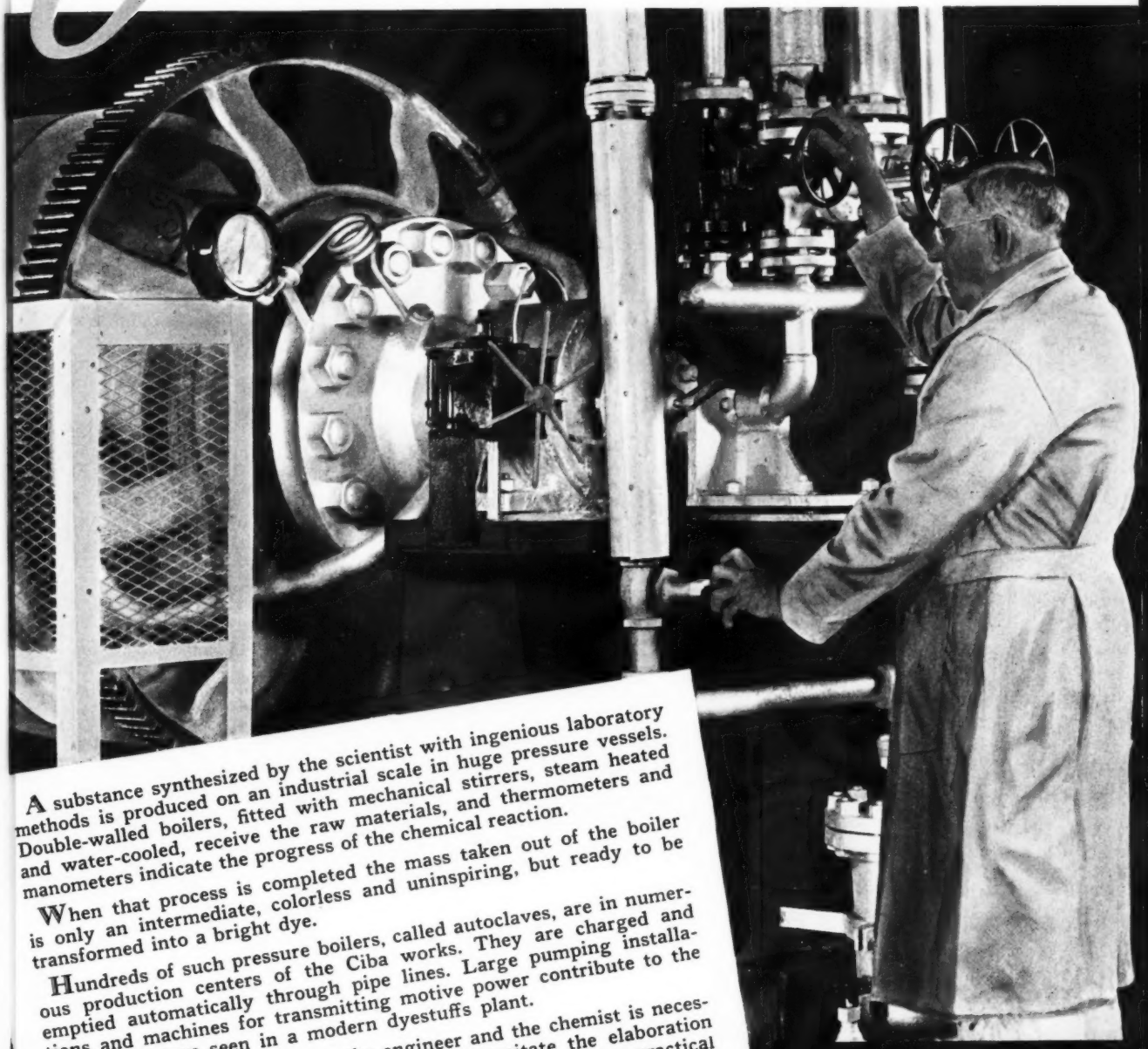
CANADIAN AGENTS:

Charles Albert Smith Limited, 123 Liberty St., Toronto, Canada

Ciba DYESTUFF GLIMPSES



A substance synthesized by the scientist with ingenious laboratory methods is produced on an industrial scale in huge pressure vessels. Double-walled boilers, fitted with mechanical stirrers, steam heated and water-cooled, receive the raw materials, and thermometers and manometers indicate the progress of the chemical reaction.

When that process is completed the mass taken out of the boiler is only an intermediate, colorless and uninspiring, but ready to be transformed into a bright dye.

Hundreds of such pressure boilers, called autoclaves, are in numerous production centers of the Ciba works. They are charged and emptied automatically through pipe lines. Large pumping installations and machines for transmitting motive power contribute to the complex picture seen in a modern dyestuffs plant.

Close collaboration between the engineer and the chemist is necessary, as chemical discoveries frequently necessitate the elaboration of absolutely new techniques before they can be utilized in a practical manner. Consequently, new methods of production have to be devised from time to time in the dyestuffs factory and obsolete methods discarded. There is hardly an industrial enterprise so incessantly in a stage of development as a large chemical concern.

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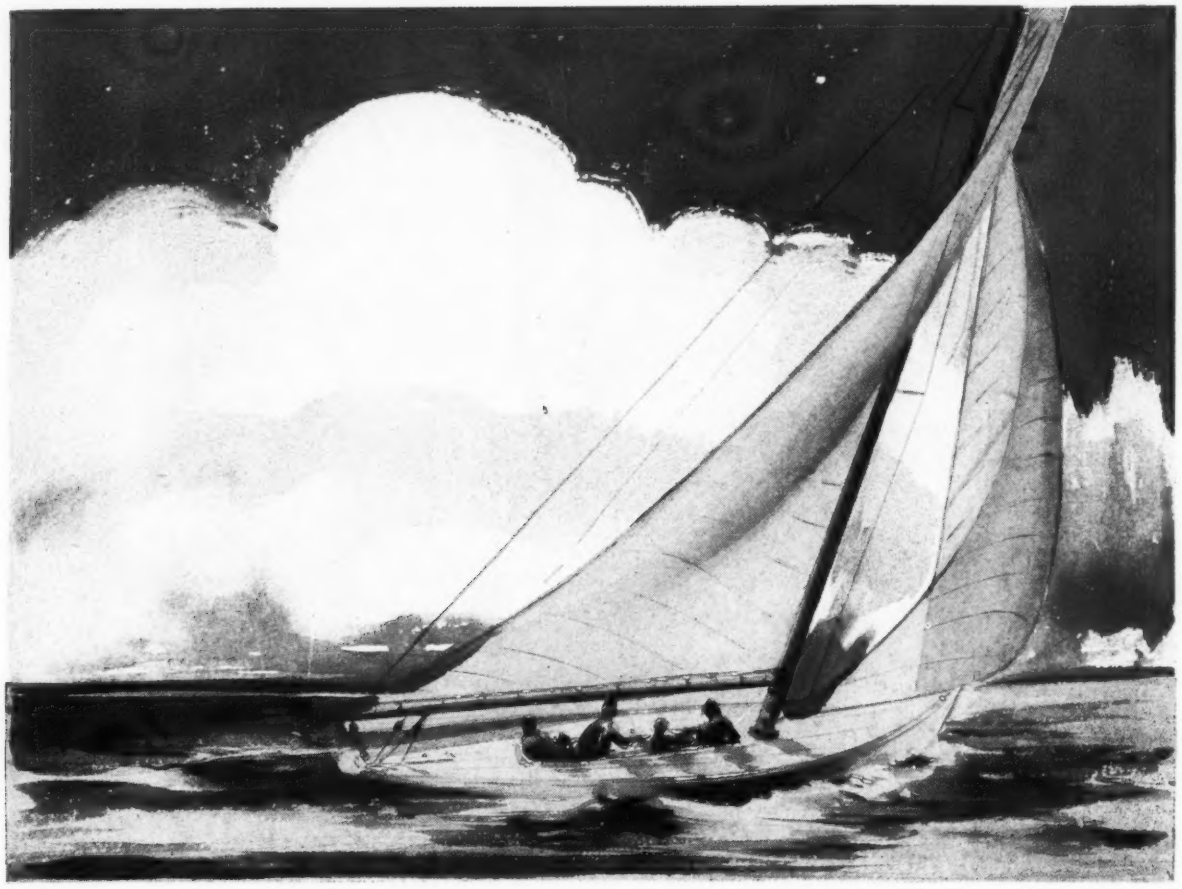

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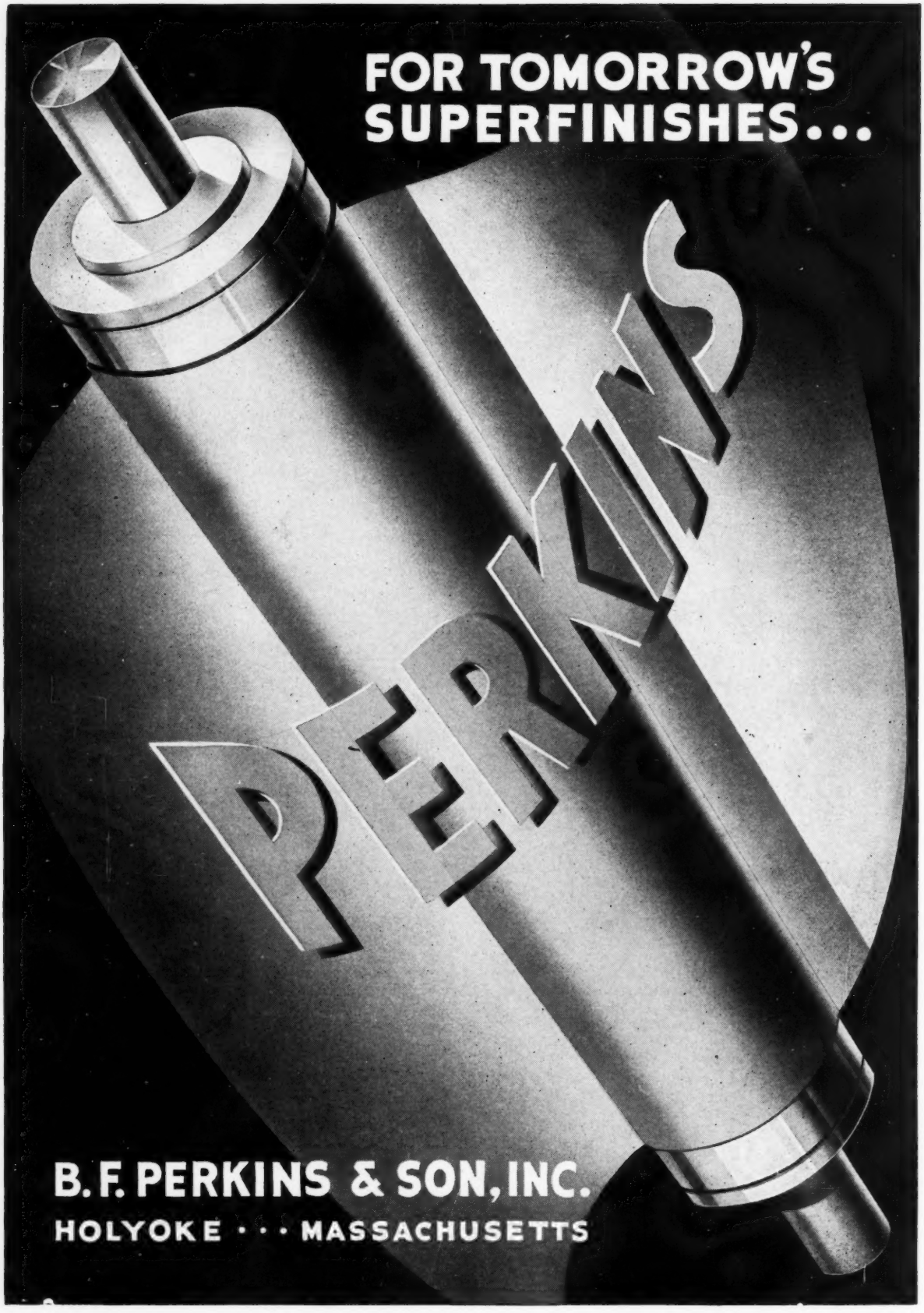
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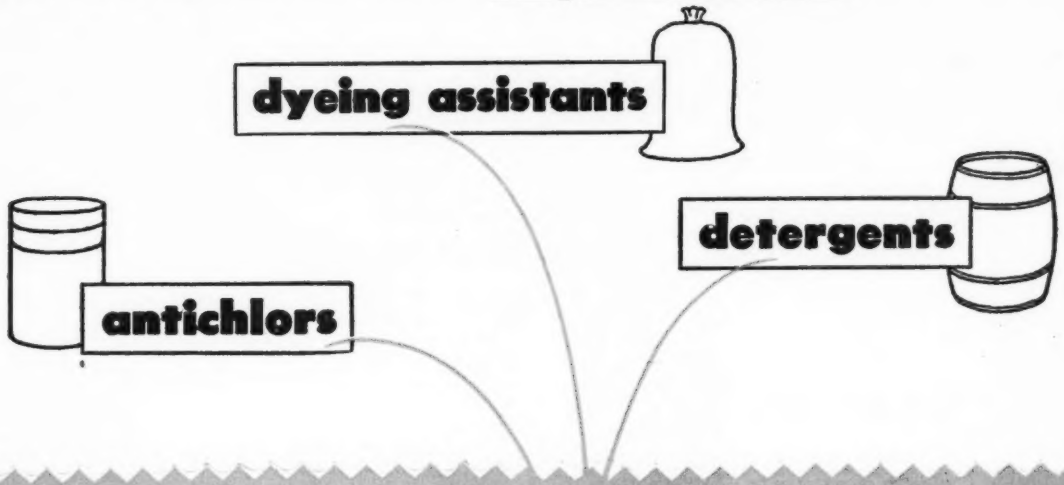

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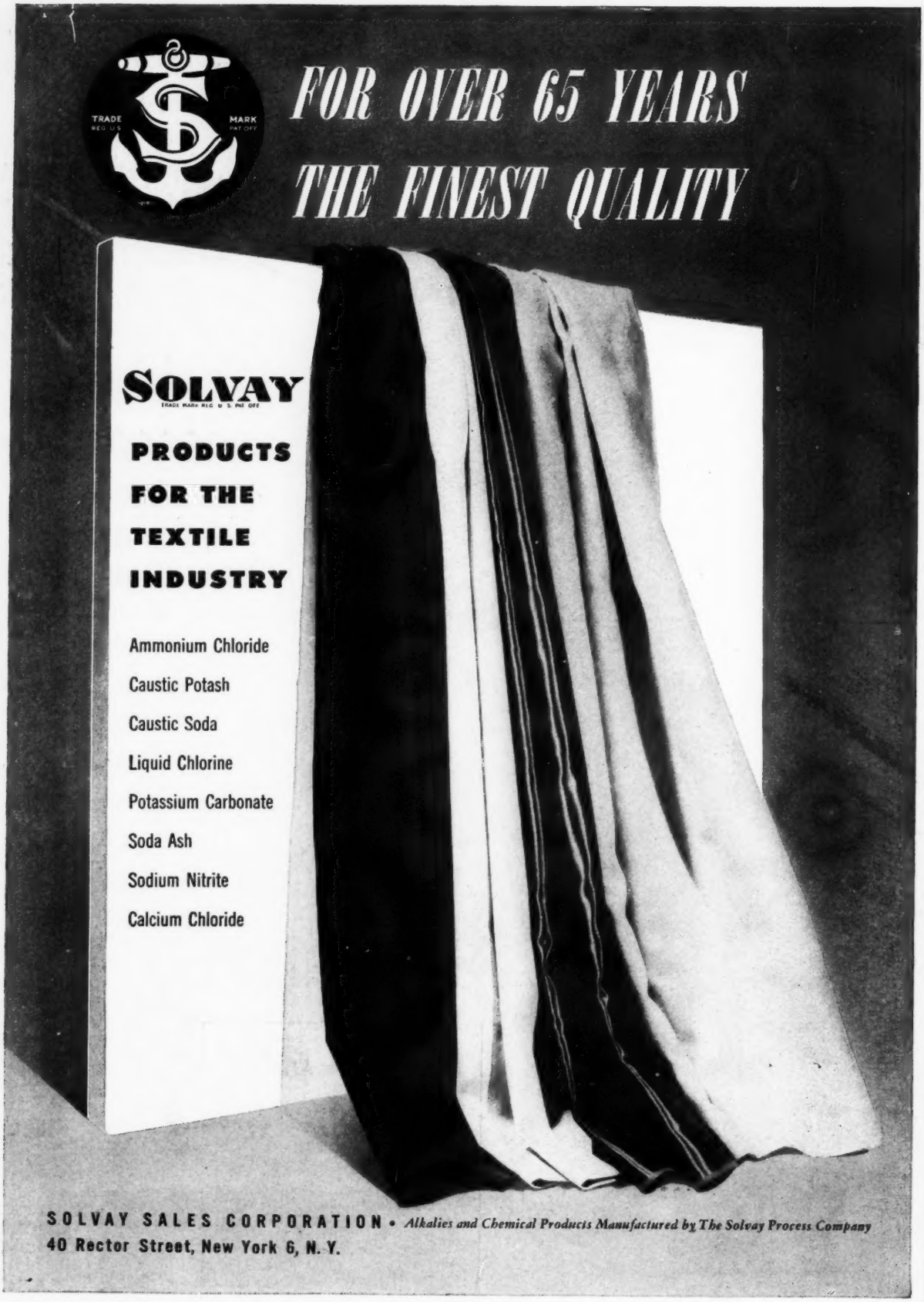
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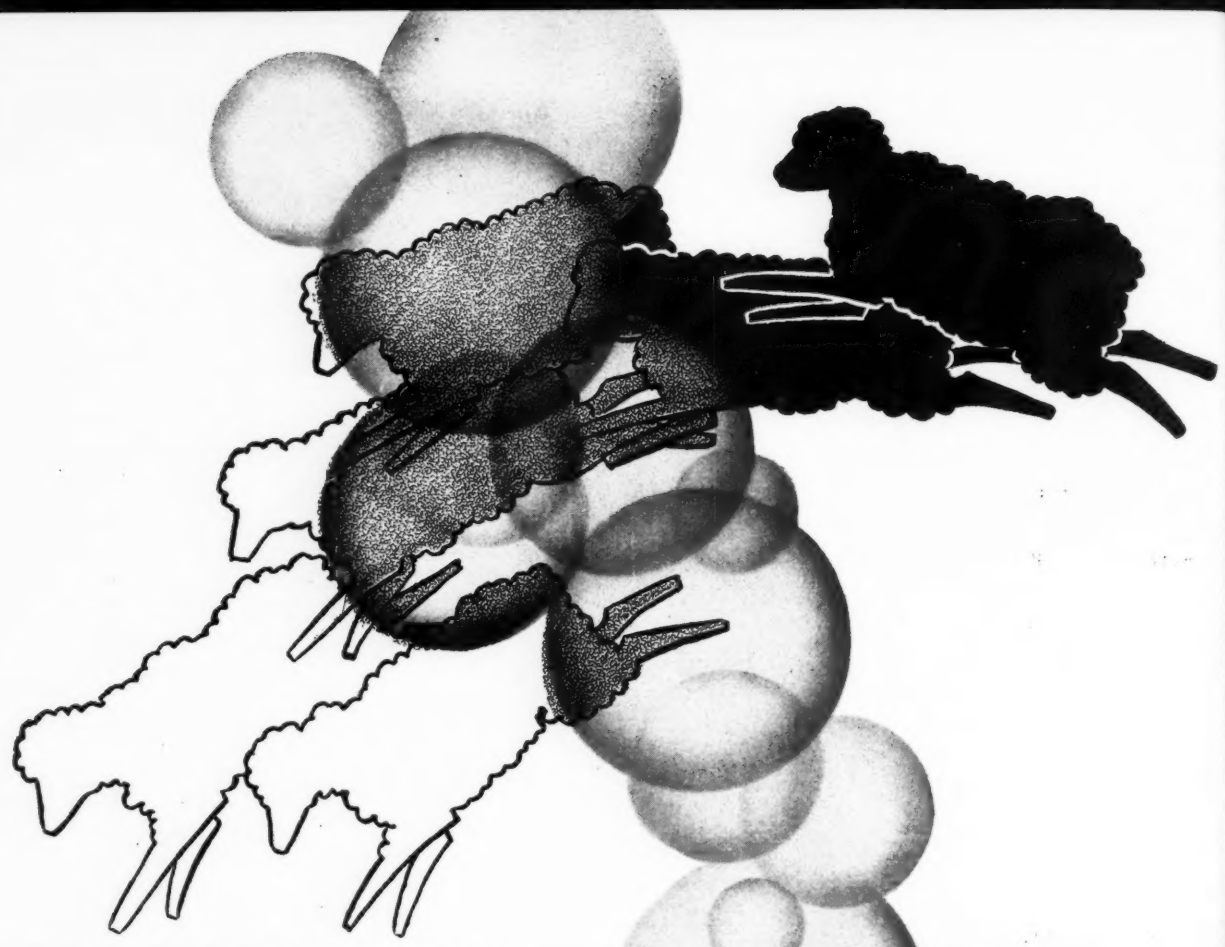

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AMERICAN
DYESTUFF REPORTER

VOLUME 36 OCTOBER 6, 1947 NUMBER 20

Cake Dyeing of Viscose Rayon

JACKSON A. WOODRUFF
Textile Research Dept., American Viscose Corp.

AT the present date the majority of viscose rayon yarn used in the textile trade is manufactured by the cake process. It has been and still is the general practice in the United States to wind skeins from the cakes in order to change the yarn into a form in which it is most easily dyed with a wide range of classes of dyestuffs. After dyeing it is again general practice to spool and/or to cone the yarn. Dyeing the yarn in the form of cakes eliminates at least one and sometimes two of these winding operations. This elimination of a costly step is well worth while but at the same time another reason for cake dyeing is to be mentioned. The yarn resulting from a properly dyed cake can be expected to be in a better condition for further processing than would be obtained from skein dyed yarn. With these advantages it has not been from lack of desire to dye cakes which has limited its greater acceptance but rather an overall lack of machinery designed for cake dyeing, a lack of knowledge of technique in dyeing, as well as the absence of cakes especially designed for dyeing. Although much progress has been made in cake dyeing during the past few years the field in which this method of dyeing can compete with skein dyeing is still considered restricted to dyeing with direct dyes and for specific end uses. It is felt that the knowledge of the trade in this country on the subject of cake dyeing is limited and that the following information will allow a better appreciation of the development and problems of cake dyeing.

A viscose rayon cake for dyeing may be described as a cylinder of continuous filament yarn having an outside diameter of/from 6 to 7 inches, an inside diameter of/from 3 to 4 inches, and a height of 3 to 4.5 inches. This cylinder is shipped to the customer in a collapsed condition in order to save shipping space. The weight of the cake for dyeing will vary from approximately 0.9 to 1.5 lbs. depending upon the manufacturer and the denier of the yarn. There are no tie bands in the cake and it is covered inside nad out with a sleeve or wrapper which protects the yarn during handling.

Development of Machinery for Dyeing

Cakes resemble skeins of short diameter and for this reason many experimenters have tried to make use of skein dyeing machines. One machine which lends itself to trials of this kind is the "cascade" type. The problems of dyeing are to obtain penetration and levelness and at the same time retain the yarn in good condition for winding. By enlarging and modifying the cross section of the dyeing arm, by removing the rotating rod, and by the use of a circular, movable, sealing flange on the end of the dyeing arm it is possible to solve the first two problems mentioned. Actually after these changes have been made the dyeing approaches the conditions of package dyeing in that the pressure of the dye liquor builds a somewhat rigid column or tube of cakes forcing a large amount of the dye liquor to flow outward from the dyeing arm through the walls of the cakes rather than flowing down through the walls by gravity as in skein dyeing. Using selected direct colors in approximately three hour dyeing cycles good dyeings can be obtained. However, due to the flexing of the cakes encountered at various times during the dyeing, rinsing, and finishing cycle the cakes are often distorted and rather poor winding is to be expected.

Another method of attacking the dyeing problems is suggested when considering a cake as a package of yarn without its center supporting tube. Work along this line has shown considerable variation and ingenuity. In many cases the central support is provided by mounting a perforated cylinder upright on a flat base plate. The diameter of the perforated cylinder approaches that of the inside diameter of the cake and height of the cylinder approaches that of the cake also. The flat base plate is cut on the bottom so as to fit into the cylinder of the next cake holder to be placed beneath it in a column of cake holders. In some instances it has been felt necessary to cover the outside of the cakes and holders with perforated cylinders or cages. The usual package dyeing spindle is used to support a column of cakes on the cake holders although the spacing of these spindles on the manifold of the machine requires adjustment in order to make room for the larger width of the cake packages. Mounted on holders and then placed on spindles in conventional pressure dyeing machines a creditable dyeing can be obtained with selected direct dyes. The spindles are mounted in either a horizontal or vertical position depending on the shape of the manifold. No appreciable difference in dyeing ability is noted between the two mountings. Two-way flow is generally used with the larger portion of time devoted to inside to outside direction. It may be mentioned that since the cake is seldom a good fit on the cake former, the outside to inside flow can cause serious distortions of the yarn due to wrinkles forming in the cake. The pressure of the dye liquor varies rather widely and in most cases little effort has been made to change from those pressures obtained in conventional package dyeing

Fig. 1 (↑) Cakes mounted on an arm for use in dyeing either on a "cascade" type machine or for use in a machine such as described by C. M. Whittaker.[1]

Fig. 2 (→) Basic model of a cake holder with and without the cakes.

machines. The bulk of the cakes dyed up to the present have been dyed by machines of this type.

In some cases special sleeves are substituted for the cake holders. In these cases a column of cakes is dressed directly on the sleeve, the diameter of which is made slightly less than that of the inside of cakes. A modification of this method is to separate each cake from the one below and above with flat circular rings which slide down the perforated or slotted sleeves. Experiments made under these conditions show that both the machines discussed by C. M. Whittaker[1] and by T. R. Smith[2] should reflect improvements in dyeing efficiency and economy. One-way flow is used and the dyeing is done at somewhat reduced pressures over those encountered in the conventional package dyeing machines.

A third line of effort has been directed toward the use of stock dyeing techniques in pressure dyeing machines. Many ways of packing as well as special containing baskets have been tried but the results have shown little promise. The problem of penetration of the thick walls of compressed filaments is difficult and by-passing or channeling of the dye liquor around the edges of the cake is general. By the use of a small range of selected direct colors and extremely long dye cycles, it is possible to obtain levelly dyed cakes. Such a method of dyeing should be reasonable only when used on high denier per filament yarns which are the easiest to penetrate.

In the B.I.O.S. Final Report #574 information is given on an application of stock dyeing technique to cake dyeing. The claims made are broad and would appear well worth investigation.

Observations of Commercial and Experimental Cake Dyeing Machines Have Shown the Following Qualifications to be of Value

1. The factor determining the ability of a machine to dye a specific type cake in a specified time limit with a specified dye or class of dyes is that of flow of dye liquor through the walls of the cake and not necessarily the amount of liquor flowing from the manifold into the spindle. The ratio of flow through the cake walls to the figure obtained by dividing the total flow through the manifold by the number of cakes in the machine varies widely with the design of the machine and with the type of cake used.

(a) For optimum dyeing conditions the flow through the walls of the cake should be as high as possible. (An arbitrary minimum for one-way flow has been established on 150/40 bright viscose cakes of 1.1 lbs. weight to be 1.5 liters per minute after a dyeing time of 1 hour at 205° F.). At the same time the total flow through the single cake dyeing machine on which this minimum was established was 2.4 liters per minute.

2. The design of the machine would be considered faulty if in order to reach a minimum necessary flow through the cake walls the total flow reached proportions which caused excessive channeling and distortion of the cakes. It is assumed the machine had been designed for the specific cake dimensions to be used in such a trial.

3. In order to decrease the chances for blowing out, channeling, or otherwise distorting the cake a means of controlling the pressure of liquor flow should be an essential part of the machine. If the predetermined dyeing pressure and flow be allowed to hit the cakes before they have had a chance to shape themselves at reduced pressures then the chances of blow outs are very likely. Starting at low pressures and building up to optimum pressure in a 5 to 15 minute period allows the successful dyeing of cakes having minor variations in dimensions but which would not stand the full pressure at the start.

4. The dyeing machine should have a means of adjustment to provide for different cake sizes. By sizes is meant the dimensional variation to be expected between the cakes received from different manufacturers as well as the dimensional variations to be expected between varying cake deniers from the same manufacturer.

5. The method of loading and unloading the machine should be kept as simple as possible. The form of the cakes can be rather easily distorted by inexperienced handling and become a serious source of trouble. Therefore, the less the loading and unloading depends upon the technique of the operator the better the chance for success in dyeing and later in winding.

6. Two-way flow of circulation of dye liquor is not essential but has been the general policy in enclosed pressure dyeing machines. Its use would depend on size and shape of the cake former.

Procedures of Dyeing

In the past few years, several articles have been published dealing with cake dyeing viscose yarn in England[1,2,3,4,5] and in Europe.[2] Considerable work has been done in England on both the machinery for cake dyeing, on dyeing procedures, and on selections of dyes for dyeing.[6,7,8,9] There is little that needs to be added here to the dyeing techniques with direct dyes described in the articles published for they are in general actual proven commercial dyeing formulae. It should suffice to say that dyes should be applied under conditions promoting the optimum opportunities for level dyeing and penetration of the dense masses of yarn. There are no mysterious secrets towards obtaining these conditions. Penetration of dye molecules throughout the cake mass is primarily a function of the achievement of even flow of dye liquor through all portions of the cake wall. This achievement is obviously dependent upon the design of the machine and upon the construction of the cake to be dyed. It should be borne in mind that although it is a simple operation to wet out all of a cake with water, there can be portions of the yarn which when once wet with water remain in a static condition with no more movement of liquid in or out of the area. In this case dye can only advance by diffusion through the narrow water passages beset on all sides by inviting filaments of undyed viscose. The time necessary to accom-

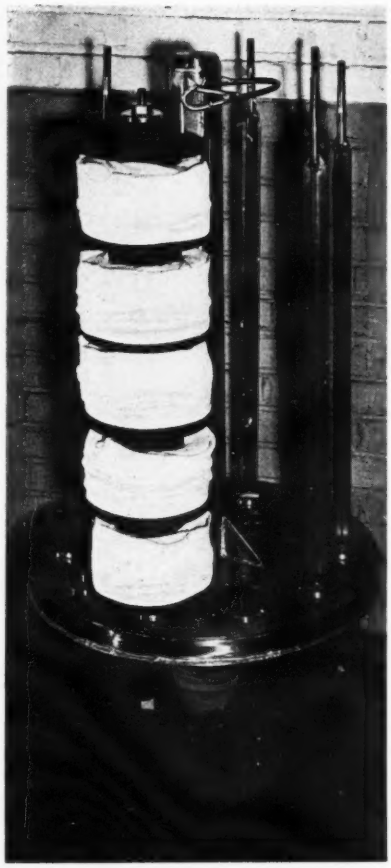

Fig. 3—Basic cake holders with cakes mounted on one spindle of the carrier of a pressure dyeing machine.

plish such diffusion is too great to be economically practical with most dyes. An exaggerated condition of this problem is shown in attempting to dye uniformly by simply placing the cake in an open container containing dye liquor. The time required to obtain penetration of the cake with the best level dyeing dyes would be far beyond a normal dyeing cycle.

Assuming a relatively uniform flow has been established, then the dyeing levelness becomes dependent upon the influence of time and the control of conditions of dyeing. It is recognized that to obtain dyeing levelness in package dyeing, it is necessary that dye ions be afforded the opportunity to move in the dye liquor to the yarn surfaces and then again to return in part to the dye liquor to the reabsorbed at a site of the yarn filaments where fewer dye ions had previously been absorbed. It is, therefore, necessary to establish those dyeing conditions which aid this movement of dye ions. When two or more dyes are involved it is necessary also in order to obtain levelness to have chosen dyes which react similarly to the dyeing conditions imposed.

Summation of Penetration of Dye

A flow of dye liquor must be maintained throughout all parts of the cake mass during the dyeing cycle.

Factors affecting flow (measured as flow through a unit portion of the cake wall.)

1. Design of the machine.
2. Properties of the cake.
   (a) Flow increases with increasing denier per filament of the yarn.
   (b) Flow decreases with increasing weight of yarn contained in the cake.
   (c) Flow increases with increased angle of wind of the yarn.
3. Flow increases with lowered viscosity of the dye liquor i.e. with increasing temperature.
4. Varying complicated conditions are produced by the use of chemicals which affect viscosity of the dye liquor and the degree of swelling of the viscose filaments.

Assuming the correct flow to be established, the following are factors concerned with levelness of dyeing.

1. The time allotted to allow the dyes to accomplish their functions.
2. Selection of dyestuffs.
   (a) Dyes which have a high rate of exhaustion without added salt but level quickly by movement in and out of the fibers.
   (b) Dyes which have a low rate of exhaustion without added salt and whose leveling can be controlled by knowledge of their salt controllability.
   (c) Dyes which have a high rate of exhaustion without added salt and whose leveling can be somewhat controlled by the use of slowly rising temperature.
3. Temperature.
   (a) Increased temperature promotes increased rate of diffusion of the dye.
   (b) Variation of the temperature of dyeing affords a means of controlling the leveling of dyes under (2.c.)
4. Salt in the dyebath.
   (a) Additions of salt increases the degree of exhaustion of direct dyes to the surface of the fibers.
   (b) Under normal dyeing conditions the addition of 2 per cent or more common salt tends to decrease the rate of movement of direct dyes within water swollen viscose.
   (c) The amount of salt provided in direct dyes as received from the manufacturer is in many cases sufficient to interfere with the dyer's attempts to control exhaustion on salt sensitive dyes.
5. Dyeing "assistants."
   (a) Chemicals which in low concentration aid in maintaining a clean clear bath are often useful.
   (b) The effects of wetting agents, retarding agents, and so called leveling agents complicate an already complex dyeing operation. The value of such chemicals usually can only be found by individual experience.
6. Soft water may be considered almost a necessity for successful cake dyeing.

The statement is made under 4(b) that under normal dyeing conditions the addi-

(Continued on Page 572)

Fig. 4—Same as Fig. 3, but including a partial view of the pressure dyeing machine.

Fig. 5—A cake of viscose rayon with the protective cover removed.

Pilot-Plant Bleaching of Cotton Fabrics

JAMES H. KETTERING and W. NORBERT BERARD

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New Orleans, Louisiana

Abstract

Physical and chemical analyses of fabrics taken at various stages of a pilot-plant procedure suitable for the kier boiling and bleaching of 100- to 200-pound lots of fabrics show that the fabrics meet present commercial standards. Formulas, liquor ratios, temperatures, description of the apparatus, and other information are given.

Introduction

AMONG the technical and scientific advances of recent years in the textile industry, none have been more pronounced or far-reaching than those which have occurred in the bleaching of cotton fabrics. The older empirical methods are being replaced by procedures which are based on a knowledge of the fundamental principles of physics and chemistry. Because of the importance of bleaching in the purification of cotton fabrics, the Southern Regional Research Laboratory of the U. S. Department of Agriculture has been investigating various bleaching operations, with the purpose of improving them and of raising the quality of the resultant fabrics.

The part of that broad program here reported concerns the development of a satisfactory pilot-plant method of bleaching small lots of fabrics.

This report includes data on the measurements of some of the essential physical and chemical properties of the fabrics and a comparison of these with the average of the measurements of the same properties on fabrics from commercial kier processes. Such information should aid the research worker as well as the practical bleacher in evaluating improvements upon the older procedures; in using of new chemicals and assistants; and in the developing and testing of new processes and equipment.

Materials

Two types of cotton fabrics were used in this investigation. For the determinations of formulas and optimum conditions, the fabric used was a poor quality gray sheeting, 40 inches wide, having 48 warp and 44 filling yarns to the inch and weighing 5.33 ounces per square yard or 3 square yards per pound. For testing uniformity and for comparison with commercially processed materials, the fabric used was a gray, premium-quality print cloth, 38.5 inches wide, having 64 warp and 56 filling yarns to the inch, and weighing 2.76 ounces per square yard or 5.80 square yards per pound.

The sheeting was chosen because it was of poor quality and difficult to bleach. It therefore offered a severe test of the bleaching process. The good quality print cloth was chosen because it is commonly found in commercial bleacheries.

Process

The process consists of the following operations:

1. Plait the cloth into the kier.
2. Add 0.25 percent RHozyme DX[2] by volume, and treat for 4 hours at 155° F. Solution to cloth ratio 4.5 to 1 by weight. Let the cloth remain in the cooling solution overnight.
3. Run the resizing solution into the drain and then wash down thoroughly in the kier with hot water.
4. Boil for 6 hours (measured from time full pressure is reached) at 15 pounds pressure (250° F.) in a solution containing 2.0 percent caustic soda (by volume) and 0.2 percent tetra sodium pyrophosphate (on the weight of the goods). Solution to cloth ratio 4.5 to 1.
5. Wash thoroughly in the kier with hot water and pull from the kier through a light squeeze into a winch (dye beck).
6. Scour with 0.5 percent neutral soap and 0.2 percent sodium carbonate (by volume) for 1 hour at 200° F. Solution to cloth ratio, 5 to 1. Rinse with hot water.
7. While still in the winch add a solution containing 1 percent hydrogen peroxide, 0.25 percent Gardinol[2] L S or other detergent (on the weight of the goods), enough sodium silicate to maintain the solution at a pH of 10 to 11, and bleach for 4 hours at 150° F. Solution to cloth ratio, 5 to 1. Let the cloth remain in this solution until cool.
8. Rinse with cold water, extract excess water in a hydroextractor or squeeze rolls, and dry on a tenter frame.

All equipment used except the kier was small commercial size. The pilot-plant kier (Figure 1) is approximately 6 feet tall, having a cylindrical tank 30 inches in diameter, 30 inches in height, and possessing all the operational devices and principles of the Allen-type commercial kier. It was manufactured from stainless steel and is equipped with an external steam heat exchanger and reversible circulating system. The liquor temperature and pressure are controlled by a temperature control and reverse acting, air-controlled, regulating valve.

Method of Evaluation

Kier boiling and bleaching of cotton fabrics have two main purposes: removal of noncellulose constituents and production of satisfactory whiteness with minimum damage to the fabrics. The various procedures investigated were therefore evaluated by the following analytical measures of known accuracy and precision.

Breaking strengths were determined by the raveled-strip method recommended in ASTM Designation D39-39 (*1* p. 87). Strips were cut 6 inches long by 1¼ inches wide, raveled to 1 inch and broken on a pendulum-type Scott tester between 3-inch jaws set 3 inches apart, the lower jaw traveling downward at the rate of 12 inches per minute. For purposes of comparison, breaking strength values (an average of 10 determinations) were computed to the same number of warp and of filling yarns.

Fluidities in cuprammonium hydroxide were determined after a 6-hour hot alcohol extraction in Soxhlet apparatus, using procedures recommended in ASTM Designation D539-40T, (*1*, pp. 181-186). The Conrad velocity gradient adjustment *(2,4)* was applied.

The degree of whiteness was measured in ICI (International Committee on Illumination) units on the Hunter Reflectometer *(6)* by the method given in Na-

[1] One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

[2] The use of these materials in experimental investigations is not intended as an endorsement or recommendation or to discriminate against any competing material sold for similar purposes.

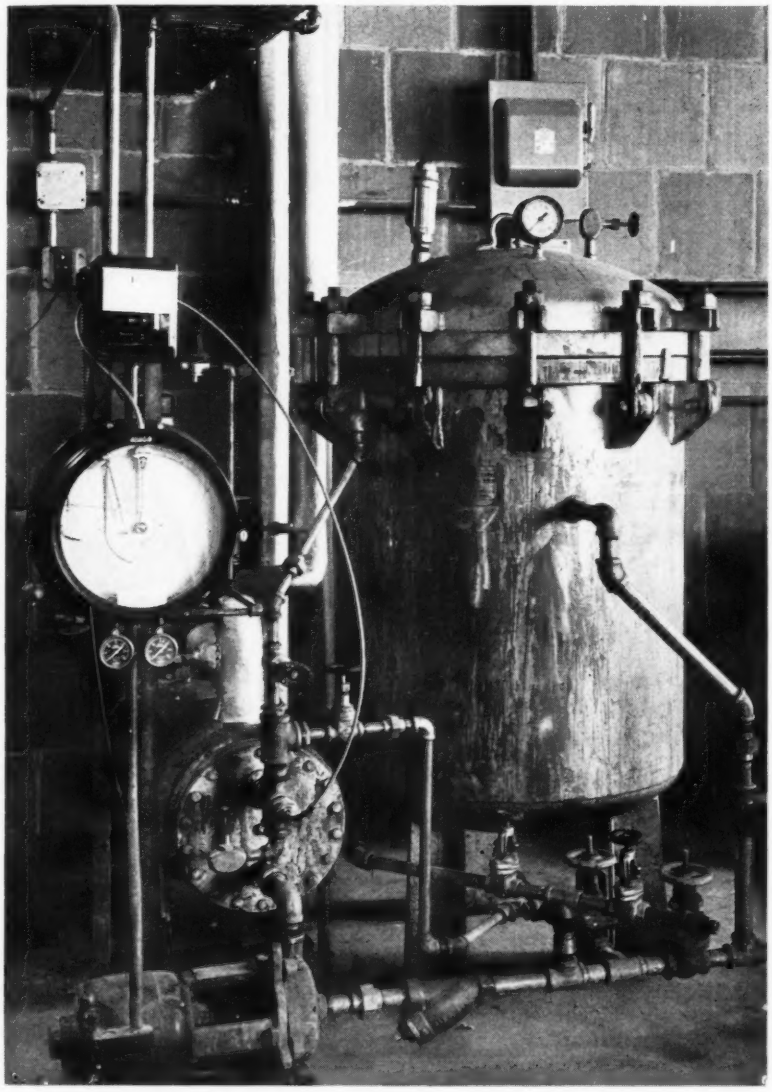

Figure 1
Pilot-Plant Kier Installed at the Southern Regional Research Laboratory

tional Bureau of Standards Circular C429 (*7*, p. 42). A whiteness of 1.000 is pure magnesium-oxide white.

Alcohol-soluble materials are the extractives from 6-hour extractions with hot alcohol (above 60° C.) in Soxhlet apparatuses. The samples were dried to constant weight in tared beakers.

Wax was determined by the Conrad method (*3*), found in a recent investigation (*8*) to be the most efficient of a number tried.

Ash was determined by the Fargher and Probert method (*5*).

Cellulose contents were determined by drying the fibers to constant weight after the extraction with monoethanolamine recommended by Reid, Nelson, and Aronovsky (*11*).

Discussion

The results with the gray sheeting are given in Table I. Even though the gray fabric was of poor quality and difficult to bleach, the finished fabric had satisfactory cellulose content, low fluidity in cuprammonium hydroxide, low quantities of residual materials (as indicated by alcohol-soluble materials), and an excellent degree of whiteness. These analyses indicate, moreover, that the scoured fabric is suitable for most purposes without bleaching. In fact, the reflectance differences between the scoured and bleached fabrics were almost within the precision of the method used and were so slight that sure visual detection of them was extremely difficult even for those accustomed to comparing whiteness differences.

Breaking strength values were lowered by desizing and kier boiling treatments. The subsequent increases in breaking strengths (Tables I, II, and III) which occurred on further processing do not necessarily indicate true gains in the strengths of the fabrics. Many factors, such as moisture content, wax removal, yarn slippage, and that group of influences called "fabric assistance" affect breaking strengths. Fluidities in cuprammonium hydroxide, which reflect changes in the cellulose itself, show consistent increases throughout all the processes.

The analytical values shown in Tables II and III were from fabrics kier boiled with caustic soda of a strength reduced to 3½ percent on the weight of the goods. As indicated, other procedures were also altered.

A desizing treatment lasting 1 hour was found to be satisfactory. Longer treatment, however, did no apparent damage to the fabrics.

Reduction of caustic strength in the kier boil resulted in high alcohol soluble materials, slightly reduced fluidities, and reduced whitenesses of the scoured although not of the bleached fabrics, and is therefore considered inadvisable. It does not appear that the savings in cost of chemicals warrant the risk of unsatisfactory processing.

The double kier boil with the goods turned appears to be unnecessary. Reflectance measurements and fluidity values showed an advantage which was far too slight to warrant the extra labor. The bleach procedure using the single boil with 2 percent caustic soda, when evaluated by appropriate physical and chemical analyses (Table I), was satisfactory. Moreover, in this bleach, there is sufficient excess of chemical reagents to assure efficient bleaching of even the fabrics most difficult to purify.

A 4-hour peroxide bleach was found to be sufficient. Although allowing the goods to remain in the bleach bath overnight did not increase fluidity enough to condemn the practice, the increase was sufficient to preclude recommendation.

Uniformity of kier boiling was demonstrated by taking fabrics (print cloth) at different levels in the kier and analyzing them for alcohol soluble materials, ash, and whiteness. The results (Table IV) show remarkable uniformity of material at this stage in the process, which makes further purification a comparatively easy task.

Table V gives a comparison of analyses of print cloth fabrics from the above pilot-plant process with the average of similar analyses on the same fabrics from 4 commercial kier processes (*10*). The only significant difference was in the whiteness values. Fabrics from the pilot-plant process were somewhat whiter than

TABLE I—Physical and chemical analyses of cotton sheeting from pilot-plant bleaching process

Treatment	Cellulose (Dry Basis)	Alcohol-Soluble Materials (Dry Basis)	Warp Breaking Strength	Fluidity $G = 500\ Sec^{-1}$ $C=0.5g/100\ ml$	Whiteness $MgO=1.000$
	Percent	Percent	Pounds	Rhes	
Gray	89.9	1.38	59.8	2.01	0.163
Desized (4 hours)	94.6	1.00	51.8	2.07	.357
Kier boiled	96.9	.73	51.7	2.76	.721
Scoured	97.2	.36	54.1	2.74	.814
Bleached (air dried)	97.2	.26	54.0	3.59	.888
Bleached (tenter dried)	97.2	.39	53.9	3.60	.856

TABLE II—Physical and chemical analyses of cotton sheeting from pilot-plant bleaching process with reduced caustic strength and altered procedures

Treatment	Cellulose (Dry Basis)	Alcohol-Soluble Materials (Dry Basis)	Warp Breaking Strength	Fluidity $G = 500\ Sec^{-1}$ $C=0.5g/100\ ml$	Whiteness $MgO=1.000$
	Percent	Percent	Pounds	Rhes	
Gray	89.9	1.38	59.8	2.01	0.163
Desized (1 hour)	94.7	1.02	5.19	2.25	.378
Kier boiled	98.4	.88	50.7	2.29	.581
Scoured	98.4	.72	49.9	2.34	.687
Bleached (4 hours)	98.2	.48	54.5	2.61	.855
Bleached (overnight)	98.4	.38	51.5	2.97	.886
Tenter dried	97.7	.44	52.4	2.97	.872

TABLE III—Physical and chemical analyses of cotton sheeting from pilot-plant bleaching process with reduced caustic strength and altered procedures including a double kier boil

Treatment	Cellulose (Dry Basis)	Alcohol-Soluble Materials (Dry Basis)	Warp Breaking Strength	Fluidity $G = 500\ Sec^{-1}$ $C=0.5g/100\ ml$	Whiteness $MgO=1.000$
	Percent	Percent	Pounds	Rhes	
Gray	89.9	1.38	59.8	2.01	0.163
Desized	94.7	1.02	51.9	2.25	.378
Kier boiled	98.4	.88	50.7	2.29	.581
Kier boiled twice (goods turned)	98.2	.60	54.9	2.46	.711
Kier boiled, twice, scoured	98.6	.47	52.2	2.57	.714
Kier boiled twice, scoured, bleached 4 hours	98.2	.39	52.2	2.68	.834
Kier boiled twice, scoured bleached overnight	98.1	.36	51.4	3.03	.888
Same but tenter dried	97.7	.40	51.5	3.08	.887

the average commercial fabrics. This whiteness value, however, is in line with those found by Kettering and Kraemer *(9)* for commercial bleaching processes. Although the fluidities of the print cloth (Table V) are higher than those of the sheeting (Tables I, II, and III), they are still low enough to indicate fabrics of excellent quality.

Summary

The details of a pilot-plant process for kier boiling and bleaching of cotton cloth are given. Physical and chemical analyses show that the method is satisfactory and produces fabrics equal in quality with those from commercial processes. A desizing treatment with RHozyme DX[2] for 1 hour at 150° F. was found to be sufficient. Longer treatments, for operating convenience, resulted in no apparent damage to the fabrics. Reducing the caustic strength in the kier or a double kier boil did not offer sufficient advantages to warrant recommendation. A 4-hour hydrogen peroxide bleach did very little damage to the fabrics. Fabrics which remained in the bleach bath overnight were sufficiently damaged to preclude recommending such a procedure.

TABLE V—Comparison of properties of cotton print cloth after a pilot-plant bleach with the average properties of the same fabrics after four commercial bleaches

Treatment	Cellulose (Dry Basis)	Alcohol Soluble Material (Dry Basis)	Breaking Strength		Fluidity $G=500\ Sec^{-1}$ $C=0.5g/100\ ml$	Whiteness $MgO=1.000$	Wax (Dry Basis)	Ash (Dry Basis)
			Warp	Filling				
	Percent	Percent	Pounds	Pounds	Rhes		Percent	Percent
Summary of 4 commercial kier-bleach processes								
Control	91.2	1.98	47.1	27.4	2.11	0.270	1.02	1.27
Kier boiled	92.9	.48	42.8	24.6	2.81	.702	.45	.22
Bleached	98.7	.39	42.9	24.8	5.91	.809	.39	.03
Pilot-plant bleach								
Control	91.2	1.98	47.1	27.4	2.11	.270	1.02	1.27
Kier boiled	98.2	.58	36.9	22.6	3.61	.672	.57	.20
Bleached	98.9	.42	40.4	24.6	5.89	.890	.32	.10

TABLE IV—Analyses showing uniformity of kier-boiled cotton print cloth

Position of Sample	Alcohol-Soluble Materials (Dry Basis)	Ash (Dry Basis)	Whiteness $MgO=1.000$
	Per Cent	Per Cent	
Top	0.54	0.28	0.614
¼ from top	.60	.22	.646
Middle	.55	.18	.637
¾ from top	.52	.15	.680
Bottom	.48	.16	.642

Acknowledgment

Appreciation is expressed to Messrs. H. Charles Doescher, Samuel G. Gremillion, Jr., and Mrs. Rita M. Kraemer for assistance in the processing and analyses here reported.

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• Faculty Members, Texas Tech

Two new faculty members for the textile engineering department of Texas Technological College have been announced by W. M. Whyburn, president.

Stuart Frederick Shafter of Lowell, Mass., who has been working as a laboratory assistant at the Institute of Textile Technology, Charlottesville, Va., since January, 1946, will be an assistant professor, taking charge of dyeing classes and industry work.

L. O. Bunton of New Orleans, veteran of many years in the textile industry, will be lecturer, giving instruction on weaving and design, textile costing and mill organization.

Proceedings of the
American Association of Textile Chemists and Colorists

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OCTOBER 6, 1947

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Members should notify the Secretary immediately of all address changes

Report of Subcommittee on Fastness to Light

William A. Holst, Chairman

C. A. Seibert, Secretary

Report by the Chairman of a Meeting of the Committee held on June 5th, 1947, at the Hotel Pennsylvania in New York City.

THE committee has been active in continuing work along the lines reported at the March meeting. With respect to proposed modifications in the FDAR Fadeometer in order to secure improved uniformity of fading within any individual machine, our last report suggested an additional lower ring to keep the swatch holders in vertical alignment. The committee members have since tested such rings furnished by Atlas and have found that although the improvement in consistency is obtained, the convenience of use leaves much to be desired.

Atlas also proposed an alternate device, consisting of a spring clip fastened to the top of the sample holder, which clamps the existing ring firmly. This was also tested and was found very inconvenient in use.

Our most recent proposal calls for an additional lower ring or rod divided into two or three sections, fastened to the existing supports, yet easily removable for servicing, and the addition of a hook to the bottom of swatch holders, so that upper and lower hooks are engaged simultaneously on their respective rings. This proposal has been forwarded to Atlas, and they are supplying several for trial. If found as satisfactory as anticipated, Atlas will make arrangements for supplying all existing and future FDAR type machines.

On the question of a colored matte paint for sample holders to standardize radiation reflection, the Committee agreed that the gray enamel used on the newer holders was satisfactory for the present time for textiles. Atlas suggested consideration of dull finish stainless steel, and it was thought that this proposal had merit but could be deferred for future consideration and development if deemed desirable. Atlas will make some sample holders for trial and evaluation by the Committee.

On the subject of Calibration paper, considerable effort has been expended. In a conference with Mr. Appel and Dr. Launer of the Bureau of Standards on May 8th, Dr. Launer agreed to cut down the "apparent" speed of the present setting of the Bureau machine by 10 per cent, in accordance with our recommendations reported at the March meeting. He suggested consideration of a more sensitive paper, Calibration Paper E, which is a weaker dyeing of the same color used in Calibration Paper A, and might be found more suitable particularly at the lower fading levels, such as 5 or 10 hours, thereby permitting better calibration in these shorter periods.

Comparative tests have been carried out on Papers A and E, making 10 per cent variations in length of exposure at the 5, 10 and 20 hour levels. After inspection of these exposures, the Committee, in its meeting of June 5, 1947, voted to request the Bureau to prepare 50 sets of standards of Paper A for immediate use on a 20 hour basis, to be followed by Paper E for use in exposures of 2-8 hours. It was agreed that both papers could be used, but on the whole Paper A was preferred for the longer exposures, and E for the shorter.

With regard to the physical size of the standard exposures to be furnished by the Bureau, it was decided that the ½" x 2" size used in the booklets originally supplied was satisfactory for visual comparison. A special larger size, 2" x 2" will be prepared for those wishing to make spectrophotometric measurements.

Consideration was given to the tentative proposal of Dr. Launer that the requested lower fading rate of the Bureau unit be designated in terms of "textile" Fading Hours, and that another value of Fading Hour might be desired in other fields, such as paper, plastics, paints, etc. After discussion, the unanimous opinion of the Committee was that this arrangement would be extremely undesirable and that only one standard Fading Hour should exist for all industries and applications.

It now appears that we have finally arrived at the point where a definite mechanical improvement in the Fadeometer for better consistency within individual machines will soon be available, and that we have finally reached agreement with the Bureau of Standards on the fading rate of the Calibration paper. It is anticipated that the new standard exposures for Calibration Papers A and E will soon be ready for distribution by this Committee for final trial by industry, which it is hoped will eventually lead to their adoption as a standard calibration method for Fadeometers, thus eliminating to a practical degree the disturbing discrepancies in fading speed which are evident in existing Fadeometers.

Papers Submitted to Judges in Intersectional Contest

Patrick J. Kennedy, National Chairman of the Intersectional Contest Committee, has made the following statement regarding this year's contest to be held in connection with the Chicago Convention scheduled for October 23, 24 and 25:

"All technical papers for this year's Intersectional Contest have been completed and are now in the hands of the judges for our Chicago Convention.

"The subjects selected for the Contest by the various Sections indicate a wide range of interests.

"The members, I am sure, are going to recognize the excellent quality of the papers submitted.

"These papers are the results of many months of preparation and the outstanding technical ability of the members of each committee.

"By referring to the AMERICAN DYESTUFF REPORTER of September 8, 1947, you will note the high caliber of the personnel of the committees.

Patrick J. Kennedy

"Our Association is indeed fortunate in having such capable talent available to it.

"Your chairman and his National Committee want the membership to know of, and at the same time express, their deep appreciation for the wonderful cooperation of every Sectional Contest Committee."

Last Reminder!
NATIONAL CONVENTION
Chicago
October 23, 24, 25

Contest Chairman, Mid-West Section

DR. LEONARD J. ARMSTRONG, in charge of Textile Development and Technical Service Group in the Development Department of Armour & Co., Chicago, is the chairman of the Intersectional Contest Committee of the Mid-West Section of the American Association of Tex-

Dr. Leonard J. Armstrong

tile Chemists and Colorists. Dr. Armstrong received his A.B. from St. Olaf College in 1937, his M.S. from North Dakota Agricultural College in 1939 and his Ph.D. from the University of Illinois in 1942. He was employed in the Textile Chemicals Department of Rohm & Haas Co., Philadelphia, until October of 1946. He is a member of the American Chemical Society, Sigma Xi, Phi Lambda Upsilon and Alpha Chi Sigma.

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Meeting, Southeastern Section

September 13, 1947

Ralston Hotel, Columbus, Georgia

KEMPTON HAYNES presided.

Mr. Haynes introduced the guests and visitors from other sections. He called attention to the national meeting October 23, 24, and 25 at the Congress Hotel in Chicago. There are seven who expected to attend.

Mr. Haynes appointed a Nominating Committee consisting of L. L. Bamberger, Chairman, H. Gillespie Smith, E. A. Feimster, Russell Gill, and Curt Mueller.

Dr. Howard M. Waddle introduced C. P. Yih to the group. Mr. Yih was professor of chemistry at Soochow University. At the present he is employed by the Ching Foong Cotton Manufacturing Company in Shanghai. He is interested in working without renumeration in a modern finishing plant in order to learn something of our methods. He can be contacted at P. O. Box 2457, Georgia School of Technology, Atlanta, Georgia.

W. B. Griffin, Program Chairman, introduced the speaker, R. W. Jacoby, Ciba Co., Inc., Providence, R. I.

Mr. Jacoby gave an exceedingly interesting and informative talk on "Recent Developments in Finishing." The talk was well illustrated with numerous exhibits. He discussed in some detail the pad steam dyeing process, permanent finishes, non-woven disposable fabrics, starch substitutes, and fluorescent materials. The presentation was excellent.

Mr. Haynes called attention to our Intersectional Contest paper on "Protective Coatings for Cotton Duck." The Paper Committee has as its chairman J. D. Dean of the Southern Regional Research Laboratory.

Respectfully submitted,

HOWARD M. WADDLE, *Secretary*

EMPLOYMENT REGISTER

This column is open for four insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Textile Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers, who can obtain further information from the Secretary.

47-35

Education: B.S. in Textile Chemistry, North Carolina State College, 1947.

Experience: Analytical chemist, construction and operation of water purification plants, pulp and paper manufacture including bleaching; Navy technician. Age 25; single; references.

47-37

Education: Lowell Textile Evening School.

Experience: Dyer, variety of fibers, asst. foreman.

Age, 30; married; references.

All correspondence regarding the Employment Register should be sent to the National Secretary

Contest Chairman, New York Section

DANIEL P. KNOWLAND, Chief Chemist of Geigy Company, Inc., is Chairman of the Intersectional Contest Committee for the New York Section. Mr. Knowland graduated from Lowell Tex-

Daniel P. Knowland

tile Institute in 1907 and has held his present position since 1910. He is a member of the American Chemical Society, American Association for the Advancement of Science, and the following English societies: Society of Chemical Industry, Society of Dyers and Colourists, and the Textile Institute.

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Contest Chairman, Rhode Island Section

Herman C. Allen

HERMAN C. ALLEN, technician and finisher for Sayles Finishing Plants, Inc., Saylesville, Rhode Island, is chairman of the Intersectional Contest Committee for the Rhode Island Section of the American Association of Textile Chemists and Colorists. Mr. Allen graduated from the University of Maine in 1931 with a B.S. in Chemical Engineering. He joined Sayles at that time and has been with them since.

Contest Chairman, Northern New England Section

Kenneth R. Fox

KENNETH R. FOX, President of the Lowell Textile Institute, is chairman of the Intersectional Contest Committee for the Northern New England Section of the American Association of Textile Chemists and Colorists. Mr. Fox received his BTE degree from Lowell in 1938 and his SM degree from the Massachusetts Institute of Technology in 1940, where he subsequently served on the staff of the Textile Foundation. From 1941 to 1943 he served as an instructor in the Textile Division at MIT and from 1943 to 1945 as Assistant Professor of Textile Technology. He is a Fellow of the Textile Institute (England) and a member of the Boston Microchemical Society (Past President), American Physical Society, American Association of Textile Technologists, Sigma Xi and Tau Epsilon Sigma. He is a Director and Vice-President of Fabric Research Laboratories, Inc. He is further a member of the Research Committee of AATCC, a member of the Nurses' Educational Committee, Lowell General Hospital and a Trustee of the Moses Greely Parker Lecture Fund. Mr. Fox has been a contributor to numerous textile publications.

CALENDAR

PHILADELPHIA SECTION
Meetings: November 8 (Silver Anniversary Meeting, Bellevue-Stratford Hotel, Philadelphia); January 16, 1948, February 27, April 9, May 14 (Kugler's, Philadelphia).

NORTHERN NEW ENGLAND SECTION
Meetings: November 21.

NEW YORK SECTION
Meetings: December 5 (Swiss Chalet, Rochelle Park, N. J.).

NATIONAL CONVENTION
October 23, 24, 25 (Congress Hotel, Chicago).

SOUTHEASTERN SECTION
Meeting: December 6 (Atlanta, Ga.).

Last Notice!

Make your plans NOW!

National Convention

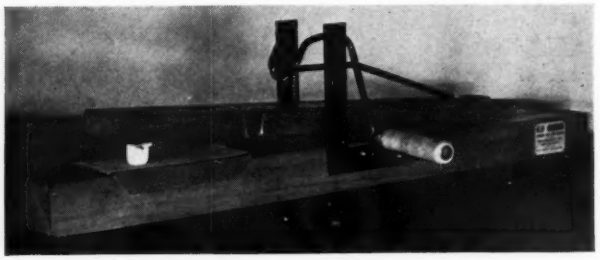
Congress Hotel, Chicago

October 23, 24, 25

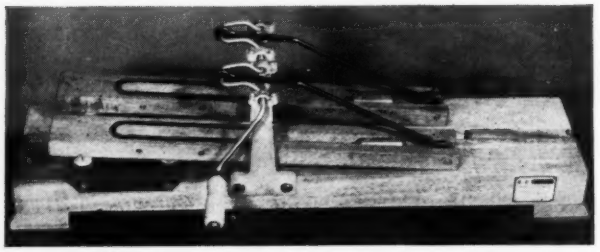
Crockmeters and Crockmeter Cloth

Revised Prices

Regular Crockmeter	$20.00
Regular Crockmeter (with automatic counter)	30.00
Duplex Crockmeter	50.00
Crockmeter Squares (500)	1.50
Crockmeter Cloth (96 x 100), by the yard	.75



Regular Crockmeter



Duplex Crockmeter

Available from the National Secretary

A New Simplified Form of the Drapemeter

JOHN H. SKINKLE* and ARTHUR J. MOREAU**

THE Drapemeter is an instrument which was suggested some years ago for the measurement of "drape" or "handle" of cloth. It consists essentially of a semicircular metal form to which the sample of fabric is attached by means of Scotch tape and from which the sample hangs downward. Due to the stiffness of the yarns parallel to the curve of the semicircle (modified to some extent by weight, weave construction, and finish) the fabric does not assume a semicircular shape all the way down the fabric, but tends to straighten out to a varying degree. A pantograph arrangement makes it possible to trace the curve of the fabric at any distance down from the curved form and it is then suggested that the chord length for each curved section be measured. For routine tests, it is suggested that the chord length at one particular level be measured and recorded. The sample tested is 4.7 x 10 inches and of course the stiffness of the yarns in the short direction is measured. The fabric must hang for ten minutes before any readings are made.

The principal objections to the Drapemeter are:

1. Attachment of the sample by Scotch tape is slow, uncertain, and in general undesirable.

2. If three tests are made on the warp and three on the filling, more than an hour is required for each fabric.

3. If the chord length is to be used for numerical evaluation, the pantograph is unnecessary; the chord length may be measured directly on the fabric.

In view of the above objections, the authors have devised a very much simplified, quicker, and more sensitive variation of the Drapemeter principle.

The apparatus (Figure 1) consists of a template 100 x 250 millimeters for cutting out the sample, a ringstand and horizontal rod from which hangs a 2½ inch wide paper clamp, another ringstand with clamp holding a millimeter rule with the rule fixed in position 100 millimeters below the jaws of the paper clamp. The template is placed on the fabric with the short dimension parallel to the set of yarns being evaluated and, with a sharp razor blade, the sample is cut out. The sample, at one end, is folded back on itself with the face of the fabric on the convex side, and the clamp is at-

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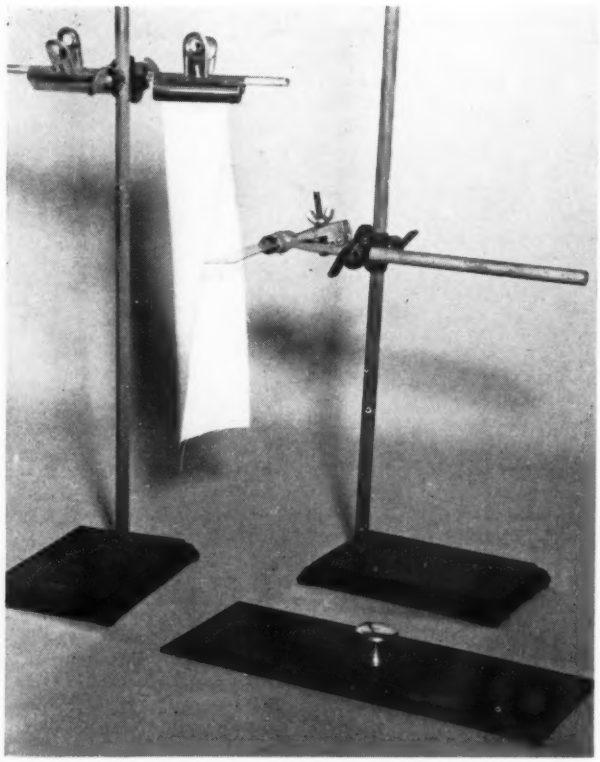

Figure 1 (←) Apparatus for New Drapemeter.

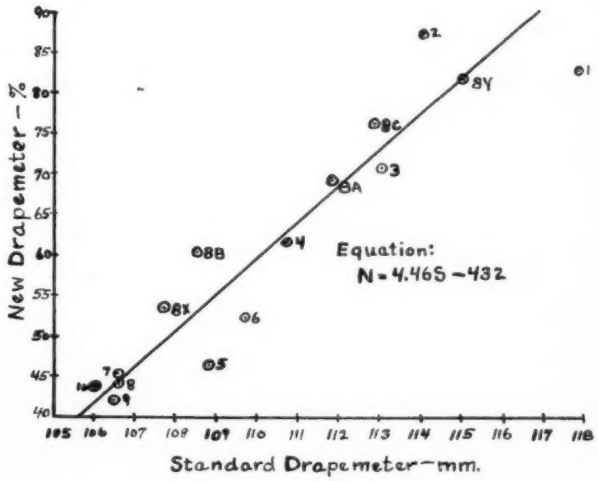

Figure 2—Comparison of New Drapemeter with Standard Drapemeter.

TABLE I

Data on Fabrics Used For Comparison

Sample Number	Fiber present	Weave and Construction	Finishing Materials
1	Cotton	Heavy duck	None
2	Cotton	Gauze	None
3	Acetate	Plain	None
4	Acetate	Plain, 200x64, warp 75d, filling 120d	None
5	Acetate warp Viscose filling	Plain, 150x75, warp 75d, filling 75d	None
6	Viscose	Sateen	None
7	Viscose	Plain	Softener
8	Spun viscose	Plain	Softener
9	Viscose	Plain, 92x64, warp 100d, filling 150d	None
10	Viscose	Plain, 92x64, warp 100d, filling 150d	None
8A	Spun viscose	Plain	5.3% UF
8B	Spun viscose	Plain	8.9% UF
8C	Spun viscose	Plain	13.2% UF
8X	Spun viscose	Plain	9.4% MF
8Y	Spun viscose	Plain	16.8% MF

Note 1: UF means "urea-formaldehyde resin", MF means "melamine-formaldehyde resin".
Note 2: Samples 9 and 10 were made to the same specifications at different times and dyed differently.
Note 3: Samples numbered 8 with a letter following are the same fabric as sample 8 but with different amounts and kinds of finishing materials.

TABLE II

Comparison of Stiffness or "Drape" on Standard Drapemeter and New Drapemeter

Sample Number	Warp		Filling		Fabric	
	Std.	New	Std.	New	Std.	New
1	116.0	78.7	119.3	87.3	117.8	82.8
2	118.1	93.2	110.3	81.5	114.0	87.2
3	109.8	62.0	116.3	80.3	113.0	70.6
4	114.3	74.7	106.8	50.7	110.7	61.6
5	112.5	50.5	105.3	42.5	108.8	46.3
6	114.3	69.8	105.3	39.0	109.7	52.2
7	107.5	44.3	105.8	46.5	106.6	45.3
8	108.3	48.8	105.0	39.8	106.6	44.1
9	109.5	53.5	103.5	40.7	106.5	42.1
10	109.0	46.8	103.0	41.0	106.0	43.8
8A	113.0	77.3	110.7	62.0	111.8	69.3
8B	113.7	69.8	103.3	52.0	108.5	60.3
8C	114.0	78.3	111.5	74.3	112.8	76.3
8X	110.7	58.8	104.7	48.5	107.7	53.4
8Y	116.0	81.8	114.0	81.3	115.0	81.6

Note 1: Figures for the standard Drapemeter are in millimeters of chord length; figures for the new Drapemeter are in millimeters also, but since the sample is 100mm wide, the figures are also percent of fabric width.
Note 2: Fabric stiffness is obtained by multiplying the warp stiffness by the filling stiffness and taking the square root of the product; that is, fabric stiffness is the geometric mean of the warp and filling values.
Note 3: All of the above values represent the mean of three determinations each on the warp and filling.

tached about one-quarter inch below the end of the fabric. The fabric and clamp are then suspended from the rod and allowed to hang for two minutes. The scale is moved up to the concave side, with one end of the scale touching one edge of the fabric, and the chord length is read in millimeters; since the sample is 100 millimeters wide, the reading is also percent of the width. Three determinations are made on the warp and three on the filling. The arithmetical average for each set of yarns is then determined and the stiffness of the fabric as a whole is computed as the geometric mean of the warp and filling (square root of warp times filling). To speed up the operation, a row of six rods may be set into a single strip of wood, the three warp and three filling samples all hung together, and the six readings made after two minutes. This gives a complete set of readings on one fabric in about five minutes. Standard testing conditions of 70° F. and 65% relative humidity should be used.

In order to compare the New Drapemeter with the Standard Drapemeter, a series of fabrics of composition as shown in Table I was used. It will be noted that ten different fabrics having a wide range of stiffness were used. On one of them (8) a series of different finishing treatments had been applied. The data on these fabrics is given in Table II.

An examination of the data of Table II reveals the following:

1. The correlation between the two methods is 85% by the Kendall coefficient, and using the fabric values. The warp correlation is a little better than this and the filling a little poorer. This is a very good correlation and indicates that both methods are measuring the same property.

2. In all cases but one (7), a difference between the warp and filling on the standard method is reflected by a difference in the same direction by the new method.

3. Samples 9 and 10 are the same construction, manufactured at different times and dyed different colors. There should be, therefore, only a small difference between these fabrics; this is true for both methods.

4. In samples 8B and 8C, the standard method shows only a small difference (4.3 millimeters) while the new method shows a greater difference (16.0 millimeters). There is considerable difference in the amount of synthetic resin present in these two samples.

5. Sample 6 is a sateen weave and should show a large difference between the warp and filling values. The standard method shows 9.0 millimeters difference, the new method shows 30.8 millimeters.

6. On the fabric values, the standard method shows a range from lowest to highest of 106 to 118 or 12 millimeters. The new method shows a range of 42 to 87 or 45 millimeters.

7. Figure 2 is a plot of the relationship between the two methods, a formula for conversion is also given.

In view of the above, it appears obvious that the new method may be substituted for the old one especially in routine testing with a saving in expense, a saving in time, increased sensitivity, and greater simplicity.

The authors also hope to use the new apparatus for measurement of resiliency by measuring stiffness as above, removing the sample, placing the sample under a standard weight completely folded for a standard length of time, rehanging and measuring the stiffness again. The decrease in the value of the stiffness, we hope, will be a measure of the lack of resiliency.

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• Brochure on Sir Samuel A. Salvage

A brochure in memory of Sir Samuel A. Salvage, father of the rayon industry in the United States, has been published by American Viscose Corporation. Sir Samuel, who came to the United States fresh from school in 1893, died on July 10, 1946.

It was at his suggestion, made to Courtauld and Company, the English textile firm, that American Viscose Corporation was organized and the first rayon plant in America was built in 1910 at Marcus Hook, Pa. Sir Samuel served first as Courtauld's American agent and sales manager, then in 1916 was elected vice-president. He was president of the corporation from May, 1925, until 1937, when he declined re-election. At the request of the shareholders he accepted the position of chairman of the board which he retained until December 31, 1939. He continued as a director and consultant until his death.

The Action of Light on Dyed and Undyed Cotton*

G. S. EGERTON

A study has been made of the effect of different conditions on the rate of photochemical degradation of cotton, undyed and dyed with different vat dyes varying greatly in their sensitizing action. Sunlight and the high-pressure mercury vapor lamp were used as sources of light energy. The extent of the photochemical degradation of the cotton was measured by the rise in the fluidity of 0.5% solution in a standard cuprammonium solvent, and by the fall in its tensile strength. The most important variables were—the pressure, composition and relative humidity of the gaseous atmosphere; the concentration of dye on the cotton ("depth of dyeing"); the physical state of the dye insofar as it is exemplified by comparisons between pigmented and dyed cotton; and the quality of the light source. Some of these factors are shown to have a great influence, not only on the absolute rate of photochemical degradation, but also on the relative rates for different dyeings. In this connection, the effect of the humidity of the atmosphere during exposures in air at atmospheric pressure is of particular importance, and of practical interest. The rate of photochemical degradation of dyeings with the strongly sensitizing vat dyes in the yellow and orange shade range is greatly increased by the presence of moisture in the air, and the same is true for undyed cotton. With dyeings of the inactive vat dyes in the green and blue shade range the rate of photochemical degradation is, on the other hand, unaffected, or but slightly affected, by the presence of moisture. A table is given comparing the rate of photochemical degradation of undyed cotton with that of the same cotton dyed with 36 different vat dyes, the samples being exposed to sunlight both in dry and in moisture-saturated air.

IT has long been known that when undyed cotton (grey, scoured or bleached) is exposed to light a progressive chemical degradation of the cellulose occurs. It has been shown that this photochemical degradation is due to oxidation of cellulose by the oxygen in the surrounding atmosphere, and that the reaction is accelerated by water vapor[1-13]. The rate of photochemical degradation of cellulose is also greatly increased by the presence in dyed cotton or other cellulose textile of many yellow and orange vat dyes of the anthraquinonoid type, although the blue and green dyes of this type have little or no such effect[12,14-19]. With undyed cotton in dry or moist air, the oxidation of the cellulose is photochemically activated by the absorption of light energy in the ultra-violet spectral region, but for cotton dyed with the "active" vat dyes, energy absorbed by the dye in the visible region of the spectrum is able to activate the cellulose oxidation. In these respects the photochemical degradation of cellulose is similar to the reaction that occurs in the photographic plate, which is rendered sensitive to light radiation of relatively long wavelength by the presence of certain colored organic compounds absorbing in suitable regions of the visible spectrum. These are known as optical sensitizers, and it may similarly be said that many yellow and orange anthraquinone vat dyes sensitize the photochemical oxidation of cellulose by gaseous oxygen and other oxidants. Examples of vat dyes that are recognized to be very active sensitizers of the cellulose reaction are Cibanone Yellow R, Cibanone Orange R, Indanthren Yellow FFRK and Caledon Yellow 5G, or equivalent commercial brands.

This paper presents a study of the effect of different conditions of exposure on the photochemical degradation of cotton, undyed, and dyed with a selection of about 40 vat dyes ranging from inactive to very active. The cotton was used in the form of yarn, and was exposed as a single layer in cells made partly or entirely of glass in which the composition of the atmosphere, its pressure or relative humidity, could be controlled. Exposures were made both to sunlight in a sun gallery facing south at Didsbury, Manchester, and to the high-pressure mercury vapor lamp (Osira, G.E.C., 400 watts unless otherwise stated), which has become familiar through its use for road lighting. The radiation from the high-pressure mercury lamp is discontinuous, its source being an arc in mercury vapor very deficient in the red, but rich in the yellow, green, blue and near ultra-violet spectral regions. The light output of the 400 watt high-pressure mercury lamp is about equal to that of a 1,000 watt tungsten filament lamp.

The oxidative reactions to which the photochemical degradation of cellulose is due are unknown in detail, and are certainly very complex. The rise in the fluidity of the cotton produced by the light exposure (denoted by $\triangle F$) has generally been used in this work as a quantitative measure of the extent of the chemical action, fluidities being measured as usual in 0.5% cuprammonium solutions at 20° C. This provides a rational though empirical scale for expressing the extent of photochemical degradation, provided that the fluidities of the original (unexposed) materials do not vary greatly. The loss in the tensile strength of the yarn on exposure ("tendering by light") has also been used as a measure of the extent of photochemical degradation in some series of experiments.

The progressive degradation of the cotton in exposures of increasing duration to the high-pressure mercury lamp can appropriately be shown by rate curves in which the fluidity rise is plotted against the duration of exposure. For exposures to sunlight this method is less satisfactory on account of the great variability of the light source. During most of the sunlight exposures measurements were therefore made of the amount of light energy incident on the samples, by means of the photographic recorder described by Farrow and Pelton[20]. The progressive degradation of the cotton is then shown by a rate curve in which the fluidity rise is plotted against the incident light energy expressed as microwatt-hours per sq. cm. per 10A at a wavelength of 4,600A. In order to permit some appreciation of the meaning of the figures obtained in daylight measurements expressed in this way, it may be useful to state that the incident

* Presented at meeting, Manchester Section, Society of Dyers and Colourists, February 21, 1947. Published in their Journal, June, 1947.

light energy in sunlight exposures at Didsbury, Manchester, for the whole month of July, 1941, was about 4,000 microwatt-hours, and about 4,500 for the whole month of June, 1944.

The Effect of Atmospheric Humidity on the Photochemical Degradation of Vat Dyed Cotton

The effect of atmospheric humidity is illustrated in Fig. 1, in which the fluidity rise of cotton dyed with Cibanone Yellow R and exposed to the high-pressure mercury lamp (250 watts) is plotted against the relative humidity of the gaseous atmosphere (1) for 245 hr. exposure in air, and (2) for 120 hr. exposure in oxygen, both at atmospheric pressure. The extent of photochemical degradation increases with relative humidity, the effect of increasing the moisture content of the atmosphere on the fluidity rise being greater for exposure in air than for exposure in oxygen, and greater in relatively dry, than in relatively moist, atmospheres, whether of air or oxygen.

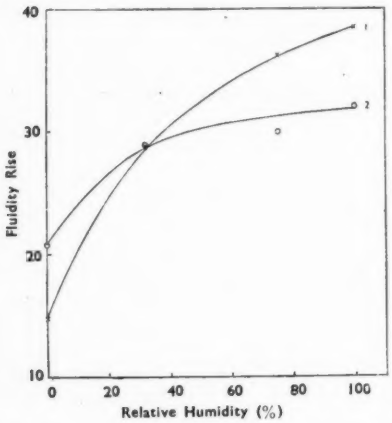

Fig. 1—Fluidity Rise and Relative Humidity. Cotton dyed with Cibanone Yellow R and exposed to H.P. Mercury Lamp (250 watt)—

1. In air for 245 hr. at atmospheric pressure.
2. In oxygen for 120 hr. at atmospheric pressure.

Rate of Degradation Curves for Cotton Dyed with Active Vat Dyes and Exposed to Light in Dry and Humid Atmospheres

The large effect of humidity on the photochemical degradation during exposure to light is further illustrated in Fig. 2 by a number of rate curves (Fluidity Rise v. Incident Light Energy) obtained by exposing a dyeing of Caledon Yellow 5G to sunlight in air and oxygen at 0% R.H. and 100% R.H. Fig. 2 shows that although dry oxygen produces much more rapid degradation than dry air at the same pressure (1,1′), the difference in the partial pressure of oxygen has a relatively small effect on the rate of photochemical degradation when the atmosphere is saturated with moisture (2,2′); this is clearly a result of the much greater effect of moisture in the air exposure (1,2) than in the oxygen exposure (1′,2′).

Very similar results to those shown for Caledon Yellow 5G in Fig. 2 were obtained with dyeings of the active vat dyes Indanthren Yellow FFRK, Indanthren Yellow GF, Cibanone Orange R, Caledon Gold Orange G and Ciba Yellow G. The progressive degradation of cotton dyed with these six dyes, and exposed to sunlight in dry and moisture-saturated air and oxygen, was also followed by measurements of tensile strength (yarn breaking load), in addition to those of fluidity.

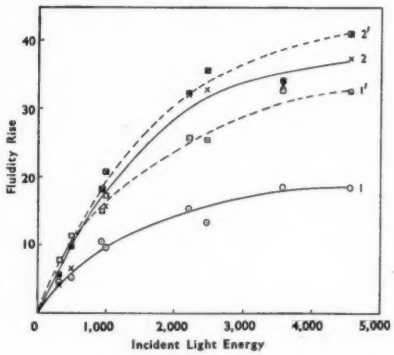

Fig. 2—Fluidity Rise and Incident Light Energy. Cotton dyed with Caledon Yellow 5G and exposed to Sunlight—
1. In air at 0% R.H.
1′. In oxygen at 0% R.H.
2. In air at 100% R.H.
2′. In oxygen at 100% R.H.

From data obtained in this way, rate curves representing % Loss in Strength v. Incident Light Energy can be constructed, and such curves are shown in Fig. 3 for the dyeing of Caledon Yellow 5G; this Figure corresponds strictly to Fig. 2, except that the index used for the extent of photochemical degradation is % Loss in Strength instead of Fluidity Rise. It can be seen that, whichever quantity is used as an index of degradation, similar conclusions must be drawn as to the effect of humidity, and of the partial pressure of oxygen, on the rate of the process.

Relation Between Fluidity Rise and Loss of Tensile Strength for Photochemically Degraded Vat Dyeings on Cotton

For all exposures of the six different vat dyeings mentioned in the previous paragraph, the relation between Fluidity Rise and % Strength Loss is shown in Fig. 4.

This relation is approximately a linear one, the same for all dyeings and conditions of exposure. A rise of fluidity of 10 units corresponds approximately to a loss of strength of 20%, but the points show

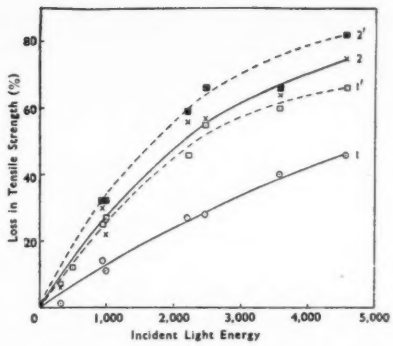

Fig. 3—Loss of Strength and Incident Light Energy. Cotton dyed with Caledon Yellow 5GG and exposed to Sunlight—

1. In air at 0% R. H.
1′. In oxygen at 0% R. H.
2. In air at 100% R.H.
2′. In oxygen at 100% R.H.

considerable scatter, as is commonly the case in such plots, and the relation between fluidity rise and strength loss for an individual exposure may differ somewhat widely from the mean. The observed correlation between strength and fluidity shows, however, that there is a general qualitative agreement, as illustrated by Figs. 2 and 3, between rate curves using, respectively, fluidity rise and strength loss as an index of the extent of the photochemical degradation of cotton.

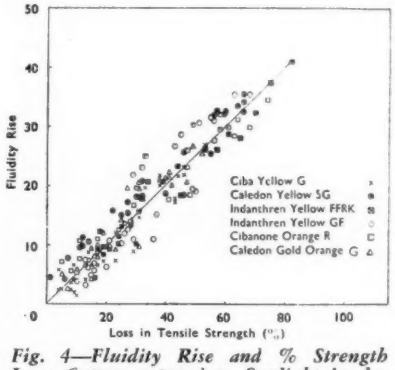

Fig. 4—Fluidity Rise and % Strength Loss. Cotton exposed to Sunlight in dry and humid Air and Oxygen after dyeing with Caledon Yellow 5G, Indanthren Yellows FFRK and GF, Cibanone Orange R, Caledon Gold Orange G and Ciba Yellow G.

Rate of Degradation Curves for Dyed Cotton containing different Concentrations of the same Active Vat Dye

The effect of the depth of dyeing (concentration of dye in the cotton) on the extent of photochemical degradation has been examined for dyeings of Cibanone Yellow R on cotton exposed to sunlight and to the high-pressure mercury lamp, both in dry and moisture-saturated air. The results are shown by a series of rate curves, in Fig. 5 for exposure to sunlight,

and in Fig. 6 for exposure to the high-pressure mercury lamp.

These two Figures relate to the same four dyeings of Cibanone Yellow R, nominally 2%, 5%, 10% and 40%, expressed as the weight of commercial dye used in the dyeing of 100 parts by weight of cotton; a rough estimate of the actual concentrations of "pure" dye in the dyed samples yielded values of 0.1%, 0.3%, 2.7% and 5.4%, respectively. For the nominal 2%, 5% and 10% dyeings the extent of photochemical degradation after a given exposure in air at 100% R.H. increases with the concentration of dye, but the degradation of the 40% dyeing is less throughout than that of the 10%, and even less than that of the 2% or 5% dyeing at low values of the incident light energy or exposure time. In dry air, where the degradation is less than in moisture-saturated air, the differences between the four dyeings are much smaller. Similar rate curves have been obtained for three other photochemically active dyes in different depths of dyeing, viz.

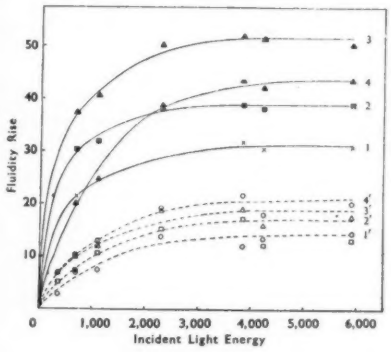

Fig. 5—Fluidity Rise and Incident Light Energy. Cotton dyed with Cibanone Yellow R and exposed to Sunlight in Air—
2% Dyeing: 1 at 100% R.H.; 1' at 0% R.H.
5% Dyeing: 2 at 100% R.H.; 2' at 0% R.H.
10% Dyeing: 3 at 100% R.H.; 3' at 0% R.H.
40% Dyeing: 4 at 100% R.H.; 4' at 0% R.H.

Indanthren Yellow FFRK, nominally 5%, 10%, 20%, 40%; Cibanone Orange R, nominally 5%, 10%, 40%, 60%; Caledon Yellow 5G, nominally 5%, 10%, 20%, 40%. In each case the rate of photochemical degradation of the most heavily dyed sample on exposure to light in air at 100% R.H. was less, or no greater, than that of the sample immediately preceding it in shade depth. As with Cibanone Yellow R, the rate of photochemical degradation with these three dyes was much less in air at 0% R.H. than in air at 100% R.H., and the differences between different depths of dyeing were also small in the dry atmosphere.

Considerable fading of the color occurred in the dyeings of Cibanone Yellow R during the longer times of exposure, both to sunlight and to the high-pressure mercury lamp, in moist air, but no fading was observed during the exposures in dry air. For all the other dyeings examined in this work, the fading of color was small at the longest exposure times employed, except with the lightest dyeing of Caledon Yellow 5G exposed in moist air.

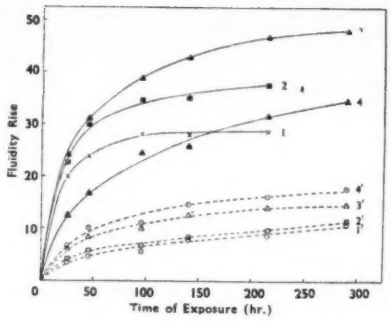

Fig. 6—Fluidity Rise and Duration of Exposure. Cotton dyed with Cibanone Yellow R and exposed to H.P. Mercury Lamp in Air—
2% Dyeing: 1 at 100% R.H.; 1' at 0% R.H.
5% Dyeing: 2 at 100% R.H.; 2' at 0% R.H.
10% Dyeing: 3 at 100% R.H.; 3' at 0% R.H.
40% Dyeing: 4 at 100% R.H.; 4' at 0% R.H.

Comparison of the Effect of the Same Active Vat Dye, Dyed and Pigmented on Cotton

The effect of light exposure on the degradation of cotton that had been pigmented, as distinct from dyed, with some of the active vat dyes was also examined. The material was prepared by immersing cotton yarn in a "pure" aqueous suspension of the precipitated dye, squeezing out the excess liquor and drying the yarn. The dye contained in such pigmented materials, unlike that in a normal vat dyeing, is only loosely held, and can be removed by washing with water. It is natural to assume that the dye in the pigmented cotton is in much less intimate contact with the cellulose, and that the dye particles are much larger than is the case with normally dyed cotton.

Table I compares the effect of 140 hr. exposure to the high-pressure mercury lamp on cotton dyed, and on cotton pigmented, with four active vat dyes. It was not possible to arrange for equal concentrations of dye in the samples dyed and pigmented with the same dye, the concentration in the pigmented samples being much higher than in the dyed samples, as is seen from the rough estimates of dye concentrations recorded in Table I.

The results show that in moisture-saturated air the extent of photochemical degradation was not very different for dyed and pigmented samples. With two of the dyes examined, this was also true for exposures in dry air, but with Caledon Yellow 5G and Indanthren Yellow FFRK the extent of degradation in dry air was much less in the pigmented than in the dyed sample; indeed, the degradation of cotton pigmented with Indanthren Yellow FFRK and exposed in dry air was no greater than that of the undyed (uncolored) cotton.

Rate of Degradation Curves for Undyed Cotton, and for Cotton Dyed with Moderately Active and Inactive Vat Dyes

Curves illustrating the rate of photochemical degradation of cotton dyed with two very active vat dyes (Fluidity Rise v. Incident Light Energy or Exposure Time) have been given in earlier paragraphs (Figs. 2, 5 and 6). Similar rate curves are shown in Fig. 7, obtained for exposures to sunlight and to the high-pressure mercury lamp of undyed cotton; of cotton dyed with Caledon Yellow 3G and Orange 2RT, which are only moderately active; and of cotton dyed with Caledon Jade Green G, which is inactive.

It is seen from Fig. 7 that the rate of photochemical degradation of the undyed cotton, like that for cotton dyed with the very active vat dyes, is much greater in moisture-saturated than in dry air, both in exposure to sunlight *(a)* and the high-pressure mercury lamp *(b)*. The same is true for the yellow and orange vat dyes, but the effect of moisture is obviously greater on the dyeing of Caledon Yellow 3G *(c, d)* than on that of Caledon Orange 2RT *(e, f)*.

TABLE I

Fluidity Rise of Cotton Dyed and Pigmented with the same Active Vat Dye and exposed to the H.P. Mercury Lamp for 140 Hr. in Dry and Humid Air

Sample		*% Dye*	*Fluidity Rise* 0% R.H.	*Fluidity Rise* 100% R.H.
Cibanone Yellow R	Dyed	2.7	12.0	34.1
	Pigmented	18.0	9.6	28.7
Cibanone Orange R	Dyed	4.5	13.9	27.2
	Pigmented	8.5	14.2	26.1
Caledon Yellow 5G	Dyed	—	12.2	23.5
	Pigmented	—	4.8	20.3
Indanthren Yellow FFRK	Dyed	2.0	9.9	20.6
	Pigmented	6.0	1.9	17.3
Undyed		0	2.2	11.8

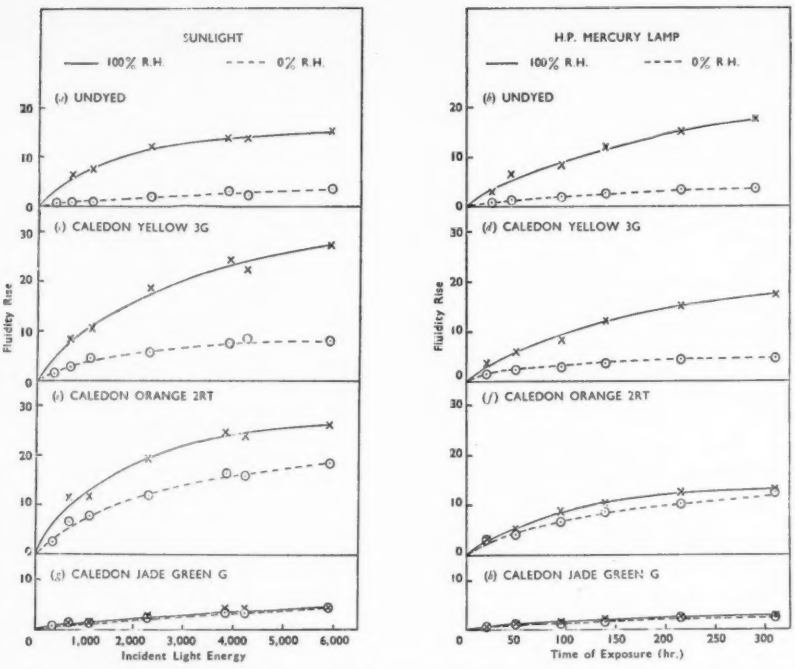

Fig. 7—Fluidity Rise and Incident Light Energy or Exposure time. Cotton undyed and dyed with Caledon Yellow 3G, Orange 2RT and Jade Green G, exposed to Sunlight (a, c, e, g) and H.P. Mercury lamp (b, d, f, h) in Air at 0% R.H. (----) and 100% R.H. (——).

The results obtained with the dyeing of the inactive dye Caledon Jade Green G show a striking difference from those given by the undyed cotton, or by dyeings of the more or less active vat dyes. The rate of photochemical degradation with this dye is virtually the same in dry and humid air, and about equal to that of undyed cotton *in dry air.* This is true for exposure both to sunlight *(g)* and to the high-pressure mercury lamp *(h).* In consequence of this behavior, Caledon Jade Green G appears to exert little effect on the photochemical degradation of cotton in dry air, but to exert a protective action against the degrading effect of light on cotton in humid air. Similar results were obtained with other inactive dyes examined, viz. Caledon Brilliant Blue R, Ciba Green G, Indanthren Khaki 2G and Indanthren Brown BR.

Comparison of the Effect of Exposure to Sunlight and to the High-Pressure Mercury Lamp

The results illustrated in earlier paragraphs show that the effects of exposure to sunlight and to the high-pressure mercury lamp are similar in many qualitative features. Quantitative differences exist, however, and this is to be expected in view of the large differences between the two light sources in the distribution of spectral energy. The relative rates of photochemical degradation of different samples exposed to the two light sources show only a partial correspondence, and this can be seen from Fig. 7; the yellow and orange vat dyeings are degraded more rapidly than undyed cotton when exposed to sunlight in the humid atmosphere (cf. *a, c, e*), but not when similarly exposed to the high-pressure mercury lamp (cf. *b, d, f*). While the high-pressure mercury lamp can be conveniently used in a study of the effect of varying conditions on the photochemical degradation of dyed and undyed cotton, it is not an adequate substitute for sunlight in practical tests of the behavior of cotton under normal conditions of light exposure during the service life of cotton textiles.

Comparison of the Activities of Different Vat Dyes on Cotton

The results so far described have shown that the rate of photochemical degradation of vat dyed cotton is influenced by many factors, and the relative activities of different dyes must be determined to some extent by the arbitrary selection of the conditions under which they are compared, e.g. the concentration of dye in the cotton, the quality of the light source, the relative humidity and composition of the oxidizing atmosphere. Rate curves of the kind that has been illustrated have been obtained for the photochemical degradation of about 40 normal vat dyeings on cotton exposed to sunlight in air at 0% and 100% R.H. These were full-shade dyeings, usually 40% of the standard commercial brands, although a few of the dyeings were made with purified dyes. The dyes were nearly all of the anthraquinonoid type, although one or two indigoid dyes were also included.

The full series of rate curves are not reproduced here, but the smoothed curves have been used to determine the fluidity rises corresponding to the incidence on the various dyeings of constant sunlight energy amounting to 5,000 microwatt-hours per sq. cm. per 10A at wavelength 4,600A; at the corresponding exposure time the differential rate of change of fluidity with duration of exposure is generally small. The values are recorded in Table II for exposures to sunlight in dry and moisture-saturated air, and they provide some empirical measure of the relative photochemical activities of the different dyes. The dyeings are arranged in Table II in order of increasing $\triangle F$ during the exposure in moist air, i.e. increasing activity of the dyes under such conditions of exposure to light.

The undyed (bleached) cotton is included in its proper order (No. 9). Dyes above this position in Table II reduce the rate of photochemical degradation of the cellulose exposed in humid air, while dyes below this position have no effect on, or accelerate, the degradation under these conditions of exposure. A different order would evidently result if the dyeings were arranged according to the fluidity rises observed during exposure in dry air. For example, the dyeing of Indanthren Gold Orange 3G (No. 15) and of Indanthren Orange 6RTK (No. 13) suffer little more degradation than undyed cotton when exposed in moist air, but much more when exposed in dry air. This is evidently a result of the relatively small effect of moisture on the rate of degradation of these dyeings. The range of degradation covered by the exposures in dry air, represented by a range of $\triangle F$ from 3 to 20, is much smaller than that observed for exposures in humid air, where $\triangle F$ varies from 3 to 52 for different dyeings. The extent of degradation of dyeings with the most active vat dyes (Nos. 30-37) exposed in dry air is not much greater than the extent of degradation of the undyed cotton exposed in humid air.

Table II illustrates well the fact that the inactive vat dyes Nos. 1-5 produce little effect on the rate of degradation of the cellulose exposed in dry air, but exert a protective effect for exposure in humid air. With some dyes (Nos. 6 and 8), the result obtained in humid air is much the same as for undyed cotton, while the result in dry air shows a considerable acceleration of the degradation; some dyes, e.g. Nos. 7 and 10, exert scarcely any effect on the rate of photochemical degradation in either dry or humid air.

TABLE II

Fluidity Rises of Dyed and Undyed Cotton exposed to Sunlight (5,000 microwatt-hours per sq. cm.) in Dry and Humid Air

No.	Dye	△F 0% R.H.	△F 100% R.H.
1	Caledon Brilliant Blue R (ICI)	3	3
2	Caledon Jade Green G (ICI)	4	4
3	Ciba Green G (Ciba)	4	6
4	Indanthren Khaki 2G (IG)	5	7
5	Indanthren Brown BR (IG)	5.5	7
6	Caledon Red BN (ICI)	9	12
7	Durindone Blue 4B (ICI)	4	13
8	Indanthren Brilliant Orange GR (IG)	10	14
9	Undyed (bleached) Cotton	3	15
10	Caledon Red 5G (ICI)	6	15
11	Caledon Red X5B (ICI)	6	15
12	Indanthren Pink FBBL (IG)	7	15
13	Indanthren Orange 6RTK (IG)	12	16
14	Caledon Red 2G (ICI)	6	17
15	Indanthren Gold Orange 3G (IG)	15	17
16	Indanthren Brilliant Orange RK (IG)	11	19
17	Algol Yellow WG (IG)	5	23
18	Indanthren Yellow 3RT (IG)	12	24
19	Indanthren Orange RRK (IG)	16	24
20	Indanthren Brilliant Orange GK (IG)	15	25
21	Cibanone Orange 6R (Ciba)	16	25
22	Caledon Orange 2RT (ICI)	17	25
23	Caledon Yellow 3G (ICI)	8	26
24	Indanthren Yellow 3GF (IG)	13	26
25	Caledon Yellow G (ICI)	16	26
26	Indanthren Yellow 7GK (IG)	10	27
27	Indanthren Golden Yellow RK (IG)	14	28
28	Durindone Scarlet Y (ICI)	10	29
29	Caledon Orange 4R (ICI)	16	30
30	Caledon Gold Orange G (ICI)	18	30
31	Indanthren Yellow 5GK (IG)	19	33
32	Cibanone Orange R (Ciba)	20	38
33	Indanthren Yellow FFRK (IG)	16	39
34	Indanthren Yellow GF (IG)	19	39
35	Indanthren Printing Yellow GOK (IG)	13	41
36	Caledon Yellow 5G (ICI)	18	46
37	Cibanone Yellow R (Ciba)	19	52

It is clear that the results obtained from exposures in air at 100% R.H. are the more significant from the strictly practical point of view. Under service conditions vat dyed cotton may not often be exposed to light in air actually saturated with water vapor, but the normal atmosphere is never free from moisture, and it is more likely to approach saturation than a state of absolute dryness. The significance of this consideration is strengthened by the fact that the effect of varying moisture content of the atmosphere on the extent of degradation is considerably less in a relative moist, than in relatively dry air (cf. Fig. 1).

The Effect of Partial Oxygen Pressure and of Exposure in Inert Gases

Results have already been described which show that the degradation of dyed cotton is greater in oxygen than in air, both in the presence and absence of water vapor. Experiments have also been made in which dyed and undyed cotton was exposed simultaneously to sunlight in dry air at different pressures, and in dry oxygen at atmospheric pressure. Table III gives the rise in fluidity observed for such an exposure of undyed cotton and cotton dyed with Caledon Yellow 5G. These results are plotted in Fig. 8 with the logarithms of the oxygen pressure as abscissae.

Similar results to those given for the dyeing of Caledon Yellow 5G have also been obtained with dyeings of Cibanone Yellow R and Cibanone Orange R. The extent of the degradation of the dyed and undyed cotton increases with the partial pressure of oxygen in the atmosphere surrounding it, as would be expected if the degradation is a process of oxidation by gaseous oxygen. In other experiments at lower pressures than those given in Table III, the fluidity rise of the dyed cotton on exposure to light was not greatly affected when the air pressure was further reduced from 0.5 mm. of mercury to a very low value, of the order of 10^{-3} mm.

TABLE III

Fluidity Rise of Undyed Cotton and Cotton Dyed with Caledon Yellow 5G exposed to Sunlight at Different Pressures of Dry Air and Oxygen

Pressure (mm. Hg)		Log of Oxygen Pressure	Fluidity Rise Caledon Yellow 5G	Fluidity Rise Undyed Cotton
0.5		— 1	3.2	0.3
5		0	4.8	0.9
15		0.5	5.3	1.6
40	Air ...	0.9	6.5	0.9
100		1.3	8.5	1.1
250		1.7	13.7	2.1
760		2.2	14.6	4.0
760	Oxygen ...	2.9	29.5	6.9

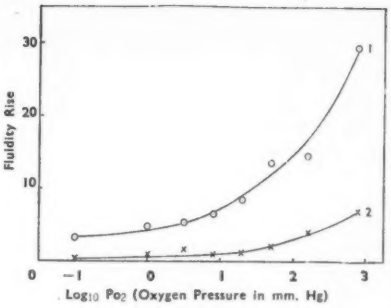

Fig. 8—Fluidity Rise and Oxygen Pressure. Cotton exposed to Sunlight at different Pressures of dry Air and Oxygen— 1. Cotton dyed with Caledon Yellow 5G. 2. Undyed Cotton.

Dyed and undyed cotton has also been exposed to the high-pressure mercury lamp in atmospheres of nitrogen and carbon dioxide. Some results for undyed cotton and cotton dyed with Cibanone Yellow R and Ciba Yellow G are given in Table IV. Very similar results have also been obtained with other dyes (Nos. 21, 25, 30-40 and 36 in Table II). These results show that the degradation is very small in atmospheres of carbon dioxide and nitrogen, both in the presence and absence of water vapor. The degradation in carbon dioxide was usually slightly less than that in nitrogen; this was possibly due to the higher purity of the former gas.

There is no evidence to show whether the small residual tendering effect which occurs in inert gases and in air at low pressures is due to traces of gaseous oxygen that are not easily eliminated from the system, or whether it is due to some secondary degradative process in which gaseous oxygen is not involved. Under normal conditions of exposure, such as are likely to prevail during the use of textiles, there can be little doubt, however, that the degradation produced is due to some process of oxidation.

Experimental

The yarn used was spun to 3/90s counts from combed Egyptian (Sakel) cotton and was scoured with caustic soda under pressure and bleached with sodium hypochlorite. A considerable number of dyeings were made with commercial vat

TABLE IV

Dyed and Undyed Cotton exposed in Various Gases to a H.P. Mercury Lamp (250 watts)

Atmosphere		Time of Exposure (hr.)	Fluidity Rise Cibanone Yellow R	Fluidity Rise Ciba Yellow G	Fluidity Rise Undyed Cotton
Carbon dioxide	0% R.H.	70	2.6	0.3	0.7
Nitrogen	0% R.H.	70	2.7	0.8	1.4
Air	0% R.H.	70	16.9	14.9	4.5
Oxygen	0% R.H.	70	28.6	20.8	4.8
Carbon dioxide	100% R.H.	45	3.0	0.7	0.9
Air	100% R.H.	45	29.0	11.2	7.7

dyes on the bleached cotton, and to more than one depth of dyeing in the case of the most active dyes. In addition, some dyeings were made with pure (Nos. 10, 13, 17) and purified (No. 35) vat dyes. The dyes were applied by customary methods from a hydrosulfite vat, and the *leuco*-dyeings were oxidized by exposure to air in the dark. The dyeings were finished by souring, washing, and, where appropriate, soaping at the boil. The original fluidities of the dyed and undyed samples (not exposed to light) showed small differences, but nearly all values fell within the range 3 to 6.

The amount of dye on the fiber was estimated in some cases by a method depending upon the intense color produced by many of these dyes when they are dissolved in concentrated sulfuric acid. From 0.01 to 0.08 g. of the air-dry specimen was dissolved in 10-50 c.c. of concentrated sulfuric acid, depending upon the depth of shade, and the solution obtained was compared visually with one made with the dye (purified by precipitation from solution in concentrated sulfuric acid) dissolved in the same solvent, diluted with concentrated sulfuric acid, until the two solutions appeared the same in depth of color.

Two types of cell were used for the exposure of the dyed and undyed cotton, viz. (1) circular brass cells and (2) rectangular glass cells. The former were 6½ in. in diameter and 1⅜ in. deep, with small inlet and outlet tubes at opposite ends of a diameter (Fig. 9).

Part of the top edge of the cell was cut away so as to support a thick glass plate (¼ in. thick, 6¼ in. in diameter). The cotton yarn was wound round a brass or glass plate, with raised ends, which could be fixed inside the cell. Picein vacuum wax was used for sealing the cells, which were heated on a water bath during the process. Two sizes of glass cell were used, viz. (1) 6½ in. × 11½ in. × 1½ in. (used for dry atmospheres) and (2) 12 in. × 12 in. × 1½ (used for moist atmospheres). These cells (Fig. 10) were constructed from pieces of glass (⅜ in. thick) ground at the edges, which were cemented together.

The top glass plate (⅛ in. thick) was sealed on these cells with Picein wax. Both types of glass cell were provided with small holes in which rubber stoppers or corks were fitted. The yarn for exposure in the glass cells was wound, by means of a coil-winder, round a card fixed on a cylindrical wooden block, and cemented at the edges of the card by an acetone solution of cellulose nitrate. The card was then cut away except for the small portions fixed to the yarn, and these were then fixed to a glass frame which fitted inside the glass cell. In the experiments described in this paper, the

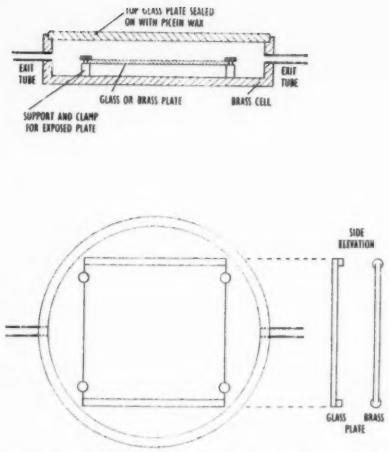

Fig. 9—Side View and Plan of Brass Cell

brass cells were used only for the exposures to the high-pressure mercury lamp and at reduced pressures.

The experimental technique did not permit a control of temperature within the exposure cells, which necessarily varied to some extent both during exposures to sunlight and to the high-pressure mercury lamp, although the conditions were in this respect more nearly constant in the latter than in the former. As a result of the heat radiated by the lamp the temperature within the cell exposed to it was always considerably higher than that of the laboratory air, and its value depended on the distance between the lamp and the exposure cell. In the experiments carried out in air and oxygen at various relative humidities between 0% and 100%, the samples were exposed in brass cells to the 250 watt high-pressure mercury lamp, the distance from the dyed cotton to the center of the lamp being 6¾ in., and under these conditions the temperature within the cell was fairly constant at 40° C. throughout the exposure.

The oxygen, nitrogen and carbon dioxide used in some experiments were supplied from cylinders, the nominal purities of the two latter being 99.6% and 99.9%, respectively. For the exposures in dry air, the gas was first dried with a mixture of anhydrous calcium chloride and magnesium oxide and finally with phosphorus pentoxide. The other gases were dried with phosphorus pentoxide alone. After passage through the cell the gas passed over phosphorus pentoxide and then through a bubble counter. The moist gases for the exposures in air and oxygen at various humidities (Fig. 1) were obtained by passing air or oxygen through sintered-glass filters immersed in the following liquids: (1) distilled water (100% R.H.), (2) saturated sodium chloride solution (75% R.H.) and (3) saturated magnesium chloride solution (32% R.H.) which were kept in a thermostat at 40° C. (the temperature of the brass cell). All the gases were passed through the cells for at least 20 hr. before the start of the exposure, and continuously during the exposure. The rate of flow of these gases varied from 10 to 60 c.c. per min., but there was no evidence that it had any significant effect on the rate of photochemical degradation.

For other exposures in moisture-saturated air in the brass cells about 15 c.c. of distilled water were placed at the bottom of the cell, which was left open to the atmosphere through the small exit tubes. No appreciable loss of water in the cell was observed during exposure. In the exposures in moisture-saturated air in the large glass cells, a zinc tray, which had been waxed all over with Picein wax, was placed at the bottom of the cell and filled with distilled water (Fig. 10). The two holes in each cell were closed with corks. Fairly considerable evaporation occurred only on extremely hot days, but the supply of distilled water was always maintained in the cell. For the exposures to sunlight in moisture-saturated oxygen (Figs. 2 and 3) each glass cell contained a tray filled with distilled water. Oxygen, humidified by passing through distilled water at room temperature, was passed through the cell for 1 hr. in the early morning and for a similar period in the late afternoon. The oxygen was passed through the cell for 20 hrs. before ex-

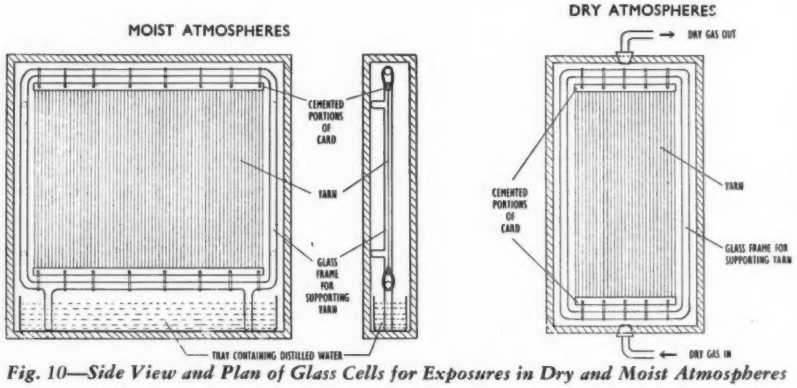

Fig. 10—Side View and Plan of Glass Cells for Exposures in Dry and Moist Atmospheres

posure began. For the exposures in moisture-saturated carbon dioxide (Table 4), this gas was bubbled through distilled water, which was kept in a thermostat at the temperature of the brass cell. The gas was passed through the cell for 20 hrs. before exposure began, then about 15 c.c. of distilled water were carefully blown over into the cell from the supply of distilled water in the thermostat so as to form a layer at the bottom of the cell comparable with that in the moist air cell, and the exposure was started.

In the exposures at reduced pressures, a rotary pump was used to evacuate the cell exposed at pressures of 0.5 mm. mercury. This was evacuated for at least 20 hrs. before exposure and continuously during the exposure from 9:30 a.m. to 5:30 p.m. on full week-days. Exposure was discontinued at the week-ends. The cells exposed at pressures from 5 to 250 mm. mercury were evacuated for 20 hrs. before exposure, filled with dry air and the pressure was then reduced to the required value. Every alternate day these cells were filled with dry air and the pressure was again reduced to the required value.

Exposures were made to sunlight behind glass, the samples being exposed at an angle of 45° to the horizontal, and to the light from the Osira high-pressure mercury vapor lamp (250 or 400 watt). These lamps have always been run vertically and samples exposed to them have been arranged symmetrically so that the center of the sample was on a level with the center of the lamps. The output at each wavelength band of the light emitted by this mercury lamp has been determined by Barnes and Forsythe[21]. The distance between the lamp and the exposure cells varied with the number of cells to be exposed simultaneously, but in all experiments required to yield comparable results this factor was naturally maintained constant. The distance from the dyed yarn to the center of the lamp was 9¾ in. for the exposures of dyeings to the 400 watt lamp (Figs. 6 and 7) and 4¼ in. for exposures in inert gases to the 250 watt lamp (Table IV).

The degradation of the cotton after exposure to light was measured by the fluidity in c.g.s. units of a 0.5% solution in cuprammonium hydroxide in the usual manner[22,23] and by measurements of tensile strength. The latter were made on a Goodbrand single-thread tester in an atmosphere at 65% R.H. and 70° F. The results given are based on the mean of 25 breaks, with a test length of 12 cm.

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Discussion

Dr. E. B. Abbot stated that photochemical effects were frequently associated with chain reactions and said that normal exposure of textile materials involved an alternation of light and darkness. He inquired whether the Lecturer had observed any differences between continuous and alternating exposures in his experiments.

The Lecturer replied that he did not think that a chain reaction was involved in the photochemical degradation of dyed and undyed cotton. He had no reason to believe that there was any material difference between continuous and alternating exposure, provided that allowance was made for certain factors which might vary in practice. In the case of sunlight with alternating periods of light and darkness, there were variations in the temperature of the yarn and in the relative humidity of the surrounding atmosphere. He had controlled the latter factor by exposing either in the complete absence of water vapor or in a fully saturated moist atmosphere. Under such conditions there was unlikely to be any difference between continuous and alternating exposure.

J. Boulton said that when the progress of photochemical change in a vat dyeing was followed by observation of color-changes, it was observed that on exposure to sunlight the dye changed in the direction of the color of its *leuco*-compound. In the dark, with normal access to oxygen, this tendency was reversed and dyes which changed readily enough to be studied in this way were seen to change in the direction of the oxidized dye. Thus, an oxidation-reduction cycle was involved in exposure to the sun followed by periods of darkness. This cycle could not operate during exposure to continuous light sources. These facts required consideration when comparing the results of exposure to sunlight and indoor sources, respectively. With regard to indoor light sources, he enquired whether the Lecturer had found that mercury lamps of the kind employed in his work had important advantages over the carbon arc as incorporated in commercial fading instruments, and, if so, what those advantages were.

The Lecturer replied that the main advantage in using the high-pressure mercury lamp for such work lay in the fact that it could be left running for substantial periods without attention. The carbon arc, as incorporated in commercial instruments, was less suitable because the instrument was not designed to hold cells of the type used in this work and also because the carbons required frequent trimming. One of the main objects had been to study the effect of humidity on the photochemical degradation of cotton. In his opinion this work would have been more difficult to carry out with the carbon arc lamp.

He was unable to agree that, on exposure to sunlight, a vat dyeing invariably changed color in the direction of the color of the *leuco*-compound of the dye. He agreed that this might be said of the dyeing of Caledon Yellow G, which turned green on exposure to light, but it was very doubtful whether the *leuco*-compound was actually formed in this case. He instanced the following as some of the colors of the alkaline (sodium) and acid (hydrogen) *leuco*-compounds of various vat dyes, formed by the reduction of the dye with alkaline hydrosulfite—

Dye	Color	
	Alkaline	*Acid*
Cibanone Yellow R	Brown	Yellow
Caledon Yellow 5G	Purple	Orange-red
Caledon Gold Orange G	Maroon-red	Orange
Cibanone Orange 6R	Orange	Yellow
Durindone Scarlet Y	Colorless	Colorless
Durindone Orange R	Yellow	Almost colorless
Durindone Pink FB	Yellow	Colorless

Some of the anthraquinonoid vat dyes, e.g. Caledon Gold Orange G, had almost the same color in the acid *leuco* and oxidized forms. Many of the thioindigoid dyes, e.g. Durindone Scarlet Y, were more or less colorless in the acid *leuco*-form, and it was with these dyes that the biggest difference in color between the acid *leuco* and oxidized forms occurred. However, in *none* of his exposures to light, either in the presence or absence of oxygen, had he observed sudden bleaching (followed by recovery of

the color in the dark) of these thioindigoid vat dyes.

Dr. P. W. Cunliffe, referring to the remarks of Dr. Abbot, said he thought that in practice the alternations of relative humidity, and therefore of regain of the dyed material, were of more importance than the alternations of light intensity. Much work along these lines had been carried out by the Society's Fastness Tests Committee in the early days of their work. He inquired whether the Lecturer had carried out any investigation on the composition of the gaseous products of photochemical decomposition. He also asked whether any protecting agents had been sought and whether the work on yarns had been correlated with similar work on single fibers. With regard to the tendering curves shown by the Lecturer, he thought it was obvious that when a curve reached a value of about 80% there was less possibility of an increase than when it reached a lower value.

The Lecturer replied that there was evidence that carbon dioxide and water were formed during the photochemical degradation of dyed and undyed cotton. Presumably these arose from the extensive oxidation of the cellulose molecule. It had been found that copper hydroxide and aluminum hydroxide (in amounts of the order of 5-10%) would reduce the photochemical degradation of undyed cotton in air at 100% R.H., although they did not do so in dry air. This statement referred to exposures to sunlight or to the high-pressure mercury lamp made behind glass. No satisfactory protective agent for cotton dyed with an active dye had, however, been found.

H. A. Turner enquired whether the intermittent illumination of exposure cells containing air at 100% R.H., with the consequent fluctuations in the temperature, might not lead to condensation and evaporation of water on the surface of the cotton, and whether this might not contribute to the tendering action through a mechanism similar to that described by Bone.

The Lecturer stated that during exposure to sunlight there was a certain amount of condensation in the cell containing air at 100% R.H., but most of this seemed to occur on the glass walls and face of the cell. This was possibly because the temperature of the yarn, due to its greater absorption of light energy, particularly in the infra-rad region, was rather higher than that of the glass.

Mr. Turner then asked whether the energy absorbed by the dye and not utilized in tendering the cellulose caused enhanced fading in those cases where protective action appeared to be exercised either by one of the dyes designated as protective or, in the experiments in moist air, through the presence of a high proportion of active dye.

The Lecturer said that where there was excessive tendering there was usually extensive fading of the dye. It was generally recognized that the inactive blue and green vat dyes were faster to light than the active yellow and orange vat dyes. He though that the explanation of this fact was that in the course of the photochemical degradation oxidizing agents were formed which could attack both the dye and the fiber. The amount formed was greater with the active dyes, so the chances of the active dye being oxidized and thus faded were greater. With those dyes which were more or less inactive, the energy absorbed was presumably dissipated mainly as heat. In certain cases, as for instance with the pigmented dyeing of Indanthren Yellow FFRK exposed to sunlight in dry air or with dyeings exposed in the absence of oxygen, the energy absorbed by the dye did not result in chemical attack of the fiber, even though the dye was active.

Mr. Turner, referring to the experiments in inert gases and at low oxygen pressures, then asked whether there was evidence of greater reduction of the dye to a free *leuco*-compound, since a photoreduced dye would presumably be unable to become reoxidized. He recalled experiments made by Dr. E. H. Goodyear in which patterns exposed in sealed tubes showed greater changes in color for certain dyes in the absence than in the presence of air. Suspensions of some vat dyes in alcohol showed greater color changes when air was rigorously excluded.

The Lecturer, in reply, stated that the only cotton dyeing which had been observed to change color on exposure to light in inert gases or at low oxygen pressures was that of Caledon Yellow G. This dyeing turned green, particularly in the absence of oxygen, but recovered on keeping in the dark for some time. It was very doubtful whether this was the hydrogen *leuco*-form, but if it were so the color produced would suggest that most of the dye had been transformed into this *leuco*-compound. A certain amount of confusion had arisen in the past through some workers suggesting that the green color produced might be a mixture of the blue *leuco*-form (the sodium derivative) with the unchanged dye. If the dye had been reduced on exposure to light it could not be to the sodium *leuco*-derivative, but presumably to the hydrogen *leuco*-compound. Assuming that Caledon Yellow G was reduced to the latter form, it would be expected, in accordance with the work of Scholefield and Turner, that this dye would cause much more rapid photochemical degradation of cotton than any other vat dye. There was little doubt, however, that Caledon Yellow G was very much less active than Caledon Yellow 5G and some of the other vat dyes. The work of Atherton and Turner (J. Soc. Dyers & Col., 1946, 62, 108) showed that on aerial oxidation, the *leuco*-form of Caledon Yellow G was transformed quantitatively into the oxidized dye and hydrogen peroxide.

Mr. Turner next said that he was surprised to hear that color changes of this kind were not observed with other dyes. He agreed that the ready change in color with flavanthrone was not necessarily a normal photo-reduction to a *leuco*-compound. There was evidence against this, e.g. the behavior of the exposed patterns on wetting, when the green color was much less stable than *leuco*-flavanthrone produced by a reducing agent.

The Lecturer said that he agreed with the remarks made by Mr. Turner regarding the difference in stability of the green color produced by the action of light on Caledon Yellow G and that of the acid *leuco*-compound. The former color reverted to the original more or less instantaneously on wetting, whereas the latter was stable (wet or dry) in the laboratory air for several hours. Furthermore, the green color when treated with dilute caustic soda was destroyed in the same way as when wetted with water. If it had been the acid *leuco*-compound then it should have turned deep blue. When a drop of dilute caustic soda was placed on cotton containing the green acid *leuco*-compound of Caledon Yellow G, there was an immediate formation of the blue sodium *leuco*-compound, which was clearly distinguishable from the green background. In view of these differences it was very difficult to believe that the green color produced by light was really due to the formation of the acid *leuco*-compound.

Mr. Turner then replied that, while simple mechanisms such as photoreductions followed by autoxidations were possibly not an adequate explanation for these phenomena, the fact that in general the same vat dyes were active in conditions where the system was undergoing an alternation of reduction and oxidation, *viz.* in tendering during dyeing, made it necessary to exercise caution before completely rejecting the intervention of a photoreduction process.

The Lecturer said that, according to the results obtained by Brear and Turner (J. Soc. Dyers & Co., 1946, *61*, 273), there were some marked differences between the effect of dyes in accelerating the normal photochemical degradation of cotton and the effect of their *leuco*-derivatives during aerial oxidation in the dark. At *p*H 7, which was the nearest equivalent to the conditions prevailing during the normal exposure of finished dyeings, aerial oxidation of the *leuco*-dyeing of Indanthren Yellow FFRK produced less degradation of cotton than did that of the *leuco*-compounds of Indanthren Brilliant

Orange GR or Ciba Blue 2B. The former yellow dye, however, was very much more active in accelerating the photochemical degradation of cotton than either of the two latter dyes.

Mr. Turner asked whether exposures had also been carried out with the material in an alkaline condition, as in his experience some dyes which would be classified as inactive on neutral exposure were very active on alkaline exposure.

The Lecturer stated that vat dyeings on cotton treated with caustic alkalis or alkali carbonates were more rapidly degraded than the untreated dyeings on exposure to light. Undyed cotton was also much more sensitive to light exposure when in the alkaline state. In one exposure to the high-pressure mercury lamp, the rises in fluidity of undyed cotton, untreated and treated with 1%, 3% and 8% aqueous solutions of sodium bicarbonate, had been 7.9, 15.0, 26.8 and 32.0 respectively. Undyed cotton treated with 8% sodium bicarbonate solution and exposed to sunlight in air at 100% R.H. suffered a substantial rise in fluidity of about 35 units after exposure for only one month. Experiments with undyed cotton and cotton dyed with active vat dyes which were exposed to light before and after treatment with sodium bicarbonate solution had suggested that, although the dyeings were more degraded than undyed cotton, the effect of the alkaline treatment was proportionately greater with the undyed cotton. It was clear that the photochemical degradation of dyed and undyed cotton would be very seriously increased if these materials were finished in an alkaline condition. In this case complaints might arise from consumers with regard to the deterioration of cellulosic textiles dyed with those dyes which were normally regarded as safe.

I. Seltzer said that Stillings and van Nostrand (*J. Amer. Chem. Soc.*, 1944, *66*, 753) had shown that after exposing cellulose to ultra-violet light some reaction continued in the dark in presence of oxygen. The reaction could be arrested by enclosing the sample in an inert atmosphere in the dark; it could then be continued by replacing in an oxygen atmosphere in the dark. This gave rise to a possible reaction mechanism of photochemical degradation —

(*a*) Dye + $h\nu$ → Dye* (some photo-activated form)

b) Cellulose + $h\nu$ → Cellulose* (photo-activated form)

These activated compounds then reacted with the surrounding atmosphere in various ways, leading finally to photochemical degradation of the cellulose. The excited forms might be stable in inert atmospheres, in which they were "frozen", but they subsequently reacted with oxygen. The half-life of these excited forms might be the determining factor in the after-exposure effect. The actual color of the dye would be effective in determining the absorption of quanta of light at specific wavelengths; dyes which absorbed in the blue region appeared to have the greatest effect in accelerating the degradation.

The Lecturer replied that Stillings and van Nostrand had investigated the action of short-wave ultra-violet light on cellulose. This was an entirely different system from that which he had been considering. Under their conditions of experimentation ozone would be formed, whereas the light which he had used was of longer wavelength and was incapable of converting oxygen into ozone. Their results with regard to the production of an unstable form of irradiated cellulose were difficult to interpret. He had never had any reason to believe that the same reaction occurred with dyed or undyed cotton after exposure to sunlight or to the high-pressure mercury lamp behind glass. He recalled some experiments in which cotton had been exposed in hydrogen peroxide vapor and said that the latter was absorbed by the cellulose, and if not washed off with water was capable of degrading the cellulose over a period of time. He suggested that this might be the case with the irradiated cellulose produced by Stillings and van Nostrand, ozone being the absorbed oxidizing agent in those experiments. He agreed, however, that if this was the case there was no obvious reason why the oxidizing action should stop in a nitrogen atmosphere, as these workers had found.

C. M. Whittaker remarked that, at one period of his work on exposure to light, he had had a frame built containing from one to eight thicknesses of glass arranged in steps. The rate of fading was the same under all thicknesses. In order to keep exposure patterns clean in the Droylsden atmosphere, not only were they exposed under glass, but each pattern was put in a Cellophane envelope. Comparative tests with and without the Cellophane envelope again revealed that there was no difference in the rate of fading. He asked what was the maximum temperature developed in the glass cell exposed to the sun. He also asked if the results had been confirmed by repetition, because one of the most difficult points in this work was the wide variation in actual commercial usage. One of the puzzling things was that the yardage of the claims for tendered curtains was only a small fraction of the yardage which had been dyed with vat dyes which accelerated photochemical degradation. If all the cloth which had been dyed in Lancashire and Yorkshire with vat dyes which accelerated photochemical degradation had become tender, it would have been the ruin of many in the dyeing and finishing trade. He had had particular difficulty in borderline cases. He had received tendered curtains dyed with Caledon Red BN, but, despite many exposures of rayon dyed with this dye, on only one occasion had he obtained a tendering effect, viz. with a pattern exposed in Bramhall, Cheshire.

The Lecturer replied that the maximum temperature developed in the glass cells exposed to sunlight was about 45° C. The results given had been confirmed by repetition. It was clear from the experiments he had described that the photochemical degradation of cotton was influenced by many factors. It was possible that variations in some of these factors were the cause of some of the puzzling results which Mr. Whittaker had described. The two factors which seemed likely to influence the behavior of a given dyeing most in practice were the humidity of the surrounding atmosphere and the *p*H of the finished dyeing.

R. Hullah enquired whether the Lecturer had any experience of the behavior of mixtures of dyes, and asked whether the tendering action of tthe active dye, Caledon Yellow 5G, would be reduced to any extent if dyed in conjunction with the protective dye, Caledon Jade Green G. If this was the case the tendering caused by a yellow vat dye might be prevented by mixing with another yellow dye possessing protective action.

The Lecturer replied that he did not think that a useful purpose would be served by using mixtures of inactive and active vat dyes. There was much evidence that the light-fastness of the inactive dye was usually adversely affected by the presence of the yellow active vat dye.

R. J. Hannay said that the variable degree of tendering noticed with certain dyes appeared to be bound up with the efficiency of the rinsing treatment given to the fabrics before being sent out, or after being laundered. Poor rinsing or the use of washing agents with a high degree of alkalinity would leave the fabric in an alkaline state, which would enhance the degree of tendering on subsequent exposure to light. He had been interested in the Lecturer's remarks on the use of certain metallic oxides and hydroxides, to act as preventatives against light-tendering by a shielding action, but felt that great care would be necessary, as it was possible to increase the tendering effect by the use of certain metallic oxides which were in general use as delustering agents, and instanced the high tendering effect of titanium dioxide and zinc oxide when used on cotton or viscose rayon fabrics. It was curious that zinc carbonate did not appear to act in this way, and he asked the Lecturer for his views on this subject.

The Lecturer replied that his statement regarding the use of certain metal-

lic hydroxides to prevent tendering by light did not refer to white pigments such as zinc oxide. This oxide and also zinc sulfide and titanium dioxide were capable of increasing the photochemical degradation of cotton or viscose rayon to a very considerable extent. He had carried out experiments in which undyed cotton had been pigmented with these white photosensitizers before exposure to light. The results had shown that in moisture-saturated air there was very considerable degradation. With zinc oxide and zinc sulfide this degradation was of the order of that produced by the most active vat dyes, e.g. Cibanone Yellow R; titanium dioxide was rather less active than these zinc compounds, although still dangerous from the practical point of view. In dry air, on the other hand, cotton pigmented in this manner suffered no more degradation than the untreated undyed cotton. It was clear that these white pigments could cause appreciable increase in the photochemical degradation of cotton, but under these conditions only in the presence of air and water vapor. Further experiments showed that if the white pigment, zinc sulfide, was precipitated on the fiber by double decomposition, then increased photochemical degradation in both dry and humid air could be observed, although the degradation was greater in the moist atmosphere. It seemed that, for the sensitization of the photochemical degradation of cotton in dry air, the sensitizer (dye or active white pigment) must be in intimate contact with the fiber. The results which had already been given for cotton dyed or pigmented with Indanthren Yellow FFRK were qualitatively very similar to those obtained with cotton pigmented with zinc sulfide, or cotton on which zinc sulfide had been precipitated.

Referring to the photochemical degradation of viscose rayon, he said that titanium dioxide had a very deleterious effect. In one exposure to sunlight, the losses in tensile strength of the bright undyed viscose rayon had been 17% in both dry and moisture-saturated air, while that of the dull undyed viscose rayon had been 10% in dry air and 100% in moisture-saturated air. Titanium dioxide appeared to have no effect in dry air, but a very marked effect in humid air.

He agreed that cotton pigmented with zinc carbonate was affected by light no more than was undyed cotton. It was not very difficult to convert the carbonate into the oxide, however, and its use as a possible delustering agent in place of the other active white photosensitizers might be attended by difficulties.

It had been shown that zinc oxide and active vat dyes such as Cibanone Yellow R produced hydrogen peroxide when they were irradiated in aqueous suspension. There was much evidence that the production of this oxidizing agent was responsible for the tendering which occurred in moisture-saturated air. In dry air or oxygen no hydrogen peroxide was produced, and an alternative mechanism to explain the degradation of dyed cotton under such conditions was necessary. It appeared that when cotton was exposed to light in dry air an oxidizing agent, which could be referred to as "activated oxygen", was formed. This agent, which had a relatively short life, was responsible for the degradation of the fiber. Unless the photosensitizer was in intimate contact with the fiber the "activated oxygen" was decomposed before it had time to degrade the fiber. This was why cotton pigmented with zinc oxide or Indanthren Yellow FFRK was no more affected by light than was undyed cotton. When the sensitizer was in intimate contact with the fiber, as with the normal dyeings or with cotton on which zinc sulfide had been precipitated, the "activated oxygen" could attack the fiber before it was decomposed and there was increased degradation.

In the presence of moisture (as well as air) it appeared that this "activated oxygen" was converted into hydrogen peroxide. This was a more stable oxidizing agent and could lead to increased degradation, even though the sensitizer was distant from the fiber as with the pigmented dyeings. Under normal conditions of exposure it would appear that two oxidizing agents could be formed, and these might have different effects under different conditions. It seemed that the sensitization of the photochemical degradation of cotton was due to the same reactions, whether the sensitizer was an active vat dye or a white pigment.

A. Lomax said that the tendering effect of light generally seemed to be most noticeable after the exposed material had been washed, and asked whether the Lecturer had any explanation of this fact.

The Lecturer replied that it was well-known that certain forms of oxidized cellulose were very susceptible to treatment with alkalis. Some types of oxycellulose, such as those prepared by oxidation of cotton with periodate, although of reasonable strength, were almost disintegrated by treatment with alkali. The degradation of cellulose by exposure to light was due to a process of oxidation and it was not unreasonable to expect that alkali-sensitive forms of oxycellulose would be formed. There was another factor to be considered as well as this, however; the wet strength of viscose rayon was much less than its dry strength, and it would be relatively easy to damage tendered viscose rayon materials during a laundering treatment.

H. R. Hadfield said that some years ago measurements of the absorption spectrum of active and inactive vat dyes had been made. It was found that all the active dyes absorbed in a certain region of the blue portion of the spectrum, while inactive dyes, including an inactive yellow dye, did not absorb in this region. This observation probably explained why an intervening layer of glass which was transparent to all visible radiations, had no effect on the tendering action.

With regard to the effect of zinc oxide, it had been demonstrated that an illuminated system of zinc oxide and water yielded titratable quantities of hydrogen peroxide, which might be responsible for the photochemical degradation of cotton containing zinc oxide. This behavior could be compared with the tendering produced by vat dyes. Active dyes, by the absorption of quanta possessing the critical energy, were reduced to the *leuco*-compounds with a corresponding oxidation of the substrate; then, on reoxidation, an equivalent quantity of hydrogen peroxide was produced.

In the case of mineral khaki, one method of production involved an oxidation of ferrous hydroxide on the fiber. It was conceivable that the tendering was caused by a similar action to that which took place in the second stage of tendering by vat dyes, i.e. by the reoxidation of the *leuco*-compound on the fiber.

The Lecturer replied that he did not think that the absorption spectrum and the activity of a dye were so simply related as Mr. Hadfield had suggested. It was recognized that light absorbed in the blue portion of the spectrum was likely to be much more effective in causing chemical change than that absorbed in the near infra-red region. This was probably why yellow vat dyes were more active than blue vat dyes. There were, however, anomalies which were difficult to explain on this basis; thus, yellow direct and green vat dyes, which absorbed in the blue region, were not generally active. It was to be regretted that little work had been published on the absorption spectra of vat dyes.

There was no evidence that active vat dyes on a cotton substrate were reduced to the *leuco*-compounds with a corresponding oxidation of the substrate, and that then on reoxidation an equivalent quantity of hydrogen peroxide was produced. The photochemical degradation that occurred in the absence of oxygen was very small and could be explained as being due to residual oxygen. A relatively similar residual effect was observed with both undyed cotton and with cotton dyed with an active dye, but there was no *leuco*-compound that could be formed in the former case. In the presence of a vat dye, reduction to the *leuco*-compound would be expected to involve substantial oxidation of the cellulose in inert gases or in a vacuum. Furthermore, the pres-

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A Study of Methods for Determining the Ash Content of Wool

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Introduction

THE clean content of a sample of scoured wool is determined by difference after estimating the total of non-wool components. The non-wool components are commonly estimated by a soxhlet extraction with ethanol to determine greasy and soapy materials, a determination of vegetable matter by any of several methods, and a determination of ash or non-volatile material. Of all of these determinations the ideal would be to have each component determined in its entirety, to have no partial duplication in determining any of the components, and to have the total of the three determinations accurately reflect the total non-wool components in the scoured sample. Actually, the vegetable matter determination must be carefully standardized and set up on such a basis that there is no duplication of ash and vegetable matter values, the extractives determination can be brought to completion but duplicates some of the ash determinations, and the ash determination tends to be low because of the easy volatilization of some of the components of the ash.

At present it would appear that the commonly used analytical methods for the determinations of extractives and vegetable matter are satisfactory, but there is little information available on the exact technique to be followed in the ash determination. A limited research was carried on in the laboratory of the Livestock Branch of the Production and Marketing Administration to give an over-all picture of the ash determination problem, and it was thought it might be of some value for publication.

The American Society for Testing Materials *(2)* lists a method for determining ash in wool felt. The sample of felt is placed in a tared crucible and subjected to a temperature of 800° to 1000° C. in a muffle furnace. Dale and Edgar *(3)* mention a similar method of determining ash in wool, in which a 5 g. sample of wool is ignited to constant weight in an electric furnace at 600° to 700° C.

The Association of Official Agricultural Chemist *(1)* has no method for determining ash in wool, but, in general, for testing for ash in various food products, recommends temperatures of 500° to 600° C.

This Association also describes a method which apparently is considered to be a standard method free from any possibility of adverse criticism. The method is as follows. The sample is charred at a low temperature; the soluble and volatile salts are then extracted from the carbon by boiling with distilled water. The solution is filtered and evaporated. Ash remaining in the carbon and on the filter paper is separately determined by ignition at 500° to 600° C. This technique is, of course, too unwieldy for routine determinations.

A technique which might have possibilities is that of dissolving the sample with heat in hydrochloric acid, density 1.10, filtering off, drying and weighing the insoluble ash, and determining the soluble ash by gentle ignition of an aliquot of the filtrate and washings.

A widely used method of ash determination is that of ignition to constant weight under the full heat of a Fisher burner. A modification of this method, found to give fairly satisfactory results in the PMA laboratory, is that of directing a gentle stream of air onto the charred wool while it is being ignited with a Fisher burner.

All the above methods were experimented with and are reported as follows:

Experimental Details

Three different samples of scoured wool were used: fine, three-eighths blood, and quarter blood in grade. Each sample was picked over thoroughly, mixing by hand and dusting out the non-volatile sand so that the ash remaining would tend to be composed principally of adsorbed salts and would exhibit to the greatest possible extent any tendency to volatilization. On each picked, mixed, dusted portion ash was determined according to the following methods:

(1) Samples were burned off on a Fisher burner until free from carbon.
(2) Samples were charred with a Fisher burner and a gentle stream of air directed onto the charred wool to facilitate burning.
(3) An electric furnace was used at temperatures of 500°, 600°, 700° 800°, and 900° C. to burn off the wool.
(4) The standard method of the Association of Official Agricultural Chemists described in the introduction was followed.
(5) Samples were tested with the hydrochloric acid method also described above.

The results follow in Table 1.

Discussion

In comparing the results in Table 1 it should be borne in mind that in the ordinary methods of analysis for clean wool content there is some duplication in the extractives and ash tests. In the PMA laboratory it has been found in general that about 7 percent of the extracts are ash. With most extract determinations ranging from 1.5 to 2.0 percent, the effect of the extractives test is to throw the total analysis for non-wool components high by some 0.11 to 0.14 percent. This tendency to high findings

Table 1. Comparisons of ash findings and time required for completing ash tests made by different methods

Sample	Determinations By: Fisher burner, No air	Fisher burner, Air blown	Furnace at various temperatures, 500° C.	600° C.	700° C.	800° C.	900° C.	AOAC	HCL
	%	%	%	%	%	%	%	%	%
Fine	1.12	1.11	1.30	1.26	1.13	1.01	0.81	1.13	0.94
⅜	1.01	0.92	1.07	1.07	1.05	0.78	0.52	0.86	0.93
¼	0.86	0.79	1.09	1.08	0.91	0.81	0.71	0.94	0.75
Ave.	1.00	0.94	1.15	1.14	1.03	0.87	0.68	0.98	0.87
Time required ...	40 min.	20 min.	4 hrs.	1½ hrs.	1 hr. 10 min.	1 hr.	40 min.	—	—

on wool impurities because of ash extractives tests might well be balanced against any tendency toward low findings in the ash tests.

In Table 1 it will be noticed that the most rapid method of determination is the use of the Fisher burner with air being blown in upon the charred sample. This technique turns out a completely burned 10 g. sample in twenty minutes, as contrasted with the shortest time of forty minutes for a 5 g. sample burned in a furnace even at the highest temperature. The furnace tests at a temperature of 500° C. (so low that there is no redness observable in the furnace) give the highest findings for ash, and presumably these would be the most accurate. However, the time required for an ash test at this temperature is four hours. The most extreme difference exhibited by the air-blown Fisher burner technique from furnace technique at 500° C. is in the case of the quarter blood wool, with a deficiency of 0.30 percent ash. Against this there should be deducted an average effect due to high findings in extractives of 0.12 percent. The resulting deficiency of 0.18 percent ash would in domestic wools have an effect on clean content of approximately 0.07 percent—an error which is almost negligible. An interesting point is that in some interlaboratory tests on clean wool content in which the PMA laboratory used the air-blown Fisher burner technique, results agreed within 0.07 percent with three other laboratories which used furnaces for ash testing.

Table 1 also indicates that for furnace results to be accurate, the ignition should be run at the lowest possible temperature. Use of temperatures of 900° C. or higher apparently results in progressively greater losses of ash. A furnace temperature of 600° C. would seem to present a good combination for accurate results within a reasonable testing period.

Conclusions

(1) A variety of methods of determining ash in wool has been used in experiments. The most accurate determinations resulted from the use of a furnace at a temperature of 500° C. This method is almost too slow to be practicable. Nearly as accurate and fairly convenient is the use of a furnace at 600° C.

(2) The use of Fisher burners in ignition, with air blown in, results in ash tests which are slightly low. With corrections made for the high findings due to the presence in extracts of an ash component, the deficiencies of the air-blown Fisher burner technique is felt to be almost negligible in its effect on clean content.

(3) A method was experimented with in which wool samples are dissolved in hydrochloric acid and ash determined in two categories—that of the insoluble ash and that present in the filtrate. Results by this technique apparently tended to be low.

References

(1) Methods of Analysis, Association of Official Agricultural Chemists, 3rd edition, 1930, page 278.

(2) A.S.T.M. Standards on Textile Materials, Sept. 1937, page 185.

(3) Dale and Edgar, Iowa State Coll. J. Sci. *16*, 391 (1941).

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Cake Dyeing

(Continued from Page 551)

tion of 2 per cent or more common salt tends to decrease the rate of movement of direct dyes within water swollen viscose. This may sound somewhat confusing considering the work of Neale[10] and of Valko.[11] To explain more fully if blocks of ⅝" x ⅝" x 2" water swollen viscose material are placed in an ordinary direct dye liquor and the progress of the dye be observed at ½ hour periods by cutting cross sections from the block the effect of salt additions to the dye liquor can be readily seen. An addition of 5 per cent common salt on the weight of viscose material will in many cases reduce the movement inward during a 3 hour period to ½ the movement shown by the same dyes during the same time if the additions of salt be withheld. The changes in the apparent rate of diffusion with respect to temperature can also be studied in this manner and are seen to be of considerable magnitude. It is the writer's opinion that observations of the effect of salt addition and of temperature change upon the movement of dyes within water swollen cellulose form a useful supplement to other dye tests used to predict the properties of the dyes in dyeing viscose yarns.

Application of Finish, Extraction, and Drying of Dyed Cakes

Publication of information of these operations has lagged behind that available on the problems of dyeing. However, in order to complete the cycle in changing undyed to dyed yarn ready for its end use some information should be given.

The actual application of the finish for the yarn is relatively simple and similar to the procedures of treating ordinary yarn packages. The desired finish is applied after a rinse at a temperature around 100°F. for a period of 5 to 20 minutes. The finish however, can be a source of trouble later in drying if it is of a type which tends to increase the migration of dye during drying. Also, for certain dyes it is necessary to apply a percentage of common salt with the finish and therefore the latter should not be easily precipitated.

The extraction of excess water is done by centrifugal whizzers. When packed in the whizzer basket the cakes should be collapsed and laid flat with the top or bottom of the cake laid along the wall of the basket. This produces somewhat less distortion of the yarn than is obtained in packing the collapsed cakes upright along the wall. The least distortion is obtained in special whizzers in which the cake is placed upright in circular form with the axis of rotation of the whizzer passing up through the center of the cake or cakes. The degree of extraction of liquor should approach the maximum possible in order to give less chance for dye migration during drying.

The field of investigation of the best type of drying machine is wide open. Because of the ease with which many direct dyes will migrate on dyed cakes during drying the present methods of drying have tended toward the use of long periods of time at reduced temperatures. The following are of importance in choosing a dryer.

1. A maximum flow of air which can can be circulated through the cake walls is the most obvious way to safely shorten the time of drying. There is little danger of disturbing the wind of the yarn so long as the cover or wrapper protects the cake.
2. The temperature should preferably be between 110°F. and 140°F. at the start since only a small amount of liquid present can cause migration of level dyeing direct dyes at temperatures above 140°F.
3. The air passing through the cakes must be kept very clean.

At present the time of drying cakes varies from 8 to over 48 hours. The longer length of time of drying indicates the use of oven dryers with no circulation through the walls of the cakes. It is usual to use perforated sleeves or cake holders similar to those used in dyeing for the drying operation in forced air flow driers.

To date the use of salt in with the finish is the only commonly accepted way of curbing migration of heavy shades dyed with level dyeing dyes.

The use of high frequency electrical driers is to be recommended as the quickest and safest way to dry dyed cakes. Excellent as such drying results may be the cost of drying is still high in comparison with steam or gas heated air.

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The Action of Light

(Concluded from Page 570)

ence of cellulose or other fiber was unnecessary for the production of hydrogen peroxide. When active vat dyes (or zinc oxide, etc.) were irradiated in aqueous suspension hydrogen peroxide was produced, although no cellulose was present. It seemed difficult to believe that the production of hydrogen peroxide by the irradiation of dyed cotton in the presence of air and water was necessarily more complex than its production by the illumination of an aqueous suspension of the same dye.

He agreed that tendering could occur by the aerial oxidation of compounds which could be readily oxidized, but emphasized that such an autoxidation process could occur in the dark. There was much evidence that hydrogen peroxide was produced by the aerial oxidation of such widely diverse compounds as metals, ferrous hydroxide, indoxyl, hydrazobenzene and *leuco*-vat dyes. Such a process was not, however, necessarily related to the photochemical production of hydrogen peroxide by vat dyes or other photosensitizers in the presence of air and water. The mechanism involved in the photochemical production of hydrogen peroxide by vat dyes and other sensitizers such as zinc oxide or titanium dioxide was probably the same, and it was clear that no *leuco*-compound of these metallic oxides could be formed. There was some evidence that another oxidizing agent, which at present could be referred to as "activated oxygen", was formed at an intermediate stage in this production of hydrogen peroxide. This "activated oxygen" could, however, be formed in the absence of water vapor and appeared to be responsible for the photochemical degradation of dyed and undyed cotton which occurred in dry air or oxygen. Some reference to this had been made in answer to a previous question from Mr. Hannay.

Dr. H. A. Thomas expressed surprise at the figures shown for increase in fluidity, which indicated that Caledon Yellow G caused a definite tendering of cotton on exposure to light at different humidities. Exposures at 65% R.H. which he had carried out with undyed cotton and cotton dyed with Caledon Yellow G indicated that the dye had a slight protective action. He also referred to Landolt's work on the fading of direct dyes dyed on top of vat-dyed cotton, and enquired whether the Lecturer had an explanation for the fact that the tendering vat dyes caused accelerated fading of many of the direct dyes.

The Lecturer replied that the hydrogen peroxide which these active vat dyes produced when they were irradiated in the presence of air and water vapor was capable of tendering the fiber and also of oxidizing any dye present. The vat dye, being more resistant to oxidation, would be less faded than the direct dye. The relation between fading and tendering had been referred to in answer to a question from Mr. Turner.

C. P. Tattersfield asked the Lecturer whether he had considered the effect of the intensity of the light source as distinct from the total quantity of light energy. He had exposed dyeings at Droylsden against the Society's Light Fastness Standards in winter and in summer, and in one or two instances dyeings had been equal to a lower standard after summer than after winter exposure. While this might be due to humidity or to a change in the energy distribution of the light at different wavelengths, it might also be a function of the average intensity of the light. He also asked whether the figures quoted for incident light energy were a measure of the total energy of the incident light or of some specific wavelength.

The Lecturer stated that there was probably a critical value below which incident light had a reduced or little effect in causing photochemical change. This value might, since the light absorption would vary with the dyeing, be different with various dyes, and this might explain the different results obtained in summer and winter. The humidity would probably be much higher in winter than in summer and this also might lead to such differences. The figures given for incident light energy referred to the total energy of the incident light for a band 10A wide at a wavelength of 4,600A.

Dr. W. Roman enquired whether the experiments with undyed cotton had been carried out with bleached or grey cotton and whether cottons of different origin showed different degrees of tendering.

The Lecturer replied that the results he had given referred to bleached cotton. Raw grey cotton was probably more resistant to light than when in the bleached state, but he did not know whether cottons of different origin would exhibit different degrees of tendering. He suggested that the deciding factor might be the presence of impurities in the cotton. The results he had quoted in reply to Mr. Turner had made it clear that the presence of alkali would considerably increase the amount of photo-chemical degradation.

TRADE NOTES • NEW PRODUCTS

• Bradford Durfee Begins 43rd Year

With a registration of 246 the Bradford Durfee Technical Institute began its 43rd year on September 15. This, the largest number ever admitted to the Institute, is more than double the number which enrolled in 1946. Seven states, besides Massachusetts, and seven foreign countries are represented. Approximately 50 per cent are veterans. There are 58 students taking chemistry courses; 94 taking engineering options and 94 taking textile courses, either manufacturing or design.

The Freshman class numbering 147 is the first to enter under the expanded collegiate program leading to the B.S. degree. The evening division registration to date is running about 15 per cent above last year.

The standing committees of the Board of Trustees of the Institute are as follows:

Committee on Education

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James Tansey, as Chairman of the Board of Trustees, is a member ex officio of all committees.

Principal Leslie B. Coombs announced the confirmation by the Board of Trustees of the following new appointments to the faculty:

Dr. D. Alexander Severino as Head of the Department of Art and Textile Design

Dr. James Watters as Head of the Department of Science

John Ferguson as Instructor in Carding and Spinning

Robert M. Gregg as Instructor in Textiles

John Greenhalgh as Instructor in Art and Textile Design

Frederick Winter as Instructor in English.

Dr. Severino received his B.S. in education in 1937 from the Massachusetts School of Art. In 1938 he received the degree of Ed.M. from Boston University, and in 1942 he was awarded the degree of Ed.D. by Harvard University. In 1939 and again in 1940 he held Carnegie Fine Arts Scholarships. He was formerly Head of the Department of Art Education at the Rhode Island College of Education. During the war he was a lieutenant, U.S.N.R. Since his discharge he has been assistant dean and instructor in art at the Rhode Island School of Design. He will replace Lucien Schimpf who resigned after 33 years of service to the Institute.

Dr. Watters comes to the Institute from Colorado, A. & M. College. He received his B.S. in Chemistry, with honors, in 1930 from Howard College and holds M.S. and D.Sc. degrees from the University of Cincinnati. His major field is organic chemistry, particularly as it applies to dyestuffs and textiles. His industrial experience includes service with the Food and Drug Administration, Federal Security Agency; Inspection Service, Bureau of Marine Inspection and Navigation, and with the Tennessee Valley Authority.

Mr. Ferguson was with the Whitin Machine Works for 12 years as a road man working in cotton, rayon and worsted mills in both the United States and Canada, installing textile machinery and operating experimental and pilot machine plants. During World War II he was an inspector of textiles for the U. S. Army. His teaching experience includes eleven years in the Textile Continuation School and eight years in the Bradford Durfee Textile School—evening division.

Mr. Gregg holds a diploma from the Bradford Durfee Textile School. He won the Cotton Manufacturers' Medal in 1933. Since graduation he has held responsible positions with the Mount Hope Finishing Company and the U. S. Testing Company in both their Cleveland and Philadelphia Laboratories. He comes to the Institute from the U. S. Bureau of Standards where he has been employed as a textile technologist working on consumer standards for textile materials. He is a member of Sub-Committee A-6 Household Furnishings of Committee D-13 American Society for Testing Materials. During the war he was an inspector of textiles for the U. S. Maritime Commission. His teaching experience includes classes in Design and Cloth Analysis, evening division, Bradford Durfee Textile School, and lecture work in Household Economics Courses—Western Reserve University.

Mr. Greenhalgh acquired a thorough training in textiles while with the American Printing Company. His training in art was acquired by years of study in private studios. For the past three years he has been an instructor in freehand drawing and oil painting with the International Ladies Garment Workers Union of Fall River. During the war he was employed at the U. S. Naval Training Station, Newport, R. I., drawing charts.

Mr. Winter has his A.B. degree from Clark University. He also has partly completed his work for a Master's degree in English at the University of Delaware. He has had 11 years experience teaching English in the Public Schools of Massachusetts and at Norwich University, Northfield, Vt. During the war he held the rank of 1st lieutenant in the Army.

• Joins Wyandotte Chemicals

Dr. A. Lloyd Taylor, formerly Vice President in Charge of Research and Development for H. L. Shaw and Sons of Portsmouth, New Hampshire and Boston, Massachusetts, who has accepted a position as Research Supervisor in the Wyandotte Chemicals Corporation Research Laboratories where his experience will be applied in the field of industrial detergents. In addition to his work on detergents in his last position, Dr. Taylor has had many years experience in the same field as Director of Research for Oakite Products and as Director of the Department of Chemistry for Pease Laboratories, New York.

During the summer extensive repairs and renewals have been made at the Institute. The latest type of fluorescent lighting has been installed in three laboratories, two clasrooms, a lecture hall, and art department, library and main office.

The renovated dye laboratory which, it had been hoped, would be ready in September will not be put in service until the second semester. In it will be installed a Smith-Drum Single Package Dyeing Machine, a Venango combination raw-stock and package dyeing machine, and a Riggs and Lombard special Fleet Line stainless steel sample dye kettle. This laboratory will accommodate 64 students.

The new equipment for the Textile Department includes 1 S-6 Crompton and Knowles Automatic Dobby Loom; 2 XD, 3 X2, and 1 XP Draper Automatic looms; a Saco-Lowell Sliver Tester and a Belger Automatic Roving Tester; a Cocker 5 can rayon slasher and a Whitin Roller card. Additional equipment will be secured as soon as orders can be placed with the builders.

The capacity of the present chemistry laboratories has been increased by remodeling to accommodate 110 additional students. The conditions will remain very crowded until the new science building can be placed in service.

When completed, the new science building will provide the Institute with the very latest in facilities for research and development work in the fields of chemical and textile engineering. The 1947 session of the General Court of Massachusetts has appropriated $200,000 toward the cost of this project which is now in the preliminary stages.

• Bibliographic Research Branch

Research Information Service is offering another unique service which was created to eliminate unnecessary and costly duplication of research work or practical experiments: the Bibliographic Research Branch makes surveys of available material—especially of foreign-language material—in any field of science and technology. Anyone engaged in research or in the development of industrial products and processes can have a complete list of all available material dealing with the subject on hand. This list will include documents pertaining to results of previously made experiments, documents showing previous mistakes which can now be avoided; the survey may uncover documents which reveal the answer to the problem in question. Manufacturers with or without research laboratories may benefit from this service which was created in order to save time, material, manpower, and money for American industry.

Inquiries regarding individual transla-

tions and bibliographic research, as well as requests for free catalogs listing the company's published translations of German research records in many industrial fields should be directed to Research Information Service, 509 Fifth Ave., New York 17, N. Y.

• Monsanto Appointment

Appointment of John W. Stewart to the New York sales and development staff of the Textile Chemicals Department, Monsanto Chemical Company, was announced recently by Dr. D. H. Powers, director of the department. Mr. Stewart's duties are concerned with the introduction to the trade of the company's textile chemicals. His headquarters will be in Monsanto's new offices at 445 Park Ave., New York City.

Mr. Stewart, until recently New England representative of the Aqua-Sec Corporation of New York, has spent more than 16 years in the textile industry. For ten years he was a technical representative for General Dyestuff Corporation, New York City. He is a native of Brattleboro, Vermont, a graduate of Lowell Textile Institute and a member of the Grand Council of Phi Psi, national textile fraternity.

• Increase in Dyestuff Prices

E. I. duPont de Nemours & Co., Inc., has announced that, effective September 8th, various dyestuffs were increased in price. Rising costs of raw materials and labor are given as the cause of this price adjustment.

Price increases range from 5 to 15 per cent, the minimum and maximum applying to dyestuff groups of relatively minor importance. Prices of some of the important dyes were not increased.

This brings the prices of duPont dyes to a level of less than 20 per cent higher than prewar.

• ASTM Technical Session On Textiles

The District Council of the American Society for Textile Materials in Philadelphia has announced a technical session on "Flammability of Textiles and New Textile Fibers and Products" to be held in Philadelphia. The meeting has been arranged in cooperation with ASTM Committee D-13. The first technical session at the Benjamin Franklin Hotel on Thursday afternoon, October 16th, will comprise a symposium on flammability of textiles with several technical papers. The second session in the evening will be held at the Philadelphia Electric Company's Edison Auditorium at which the following three addresses will be given:

Cotton Textile Fibers in Various Industrial Uses—B. L. Whittier.

Modifications of Textile Fiber Properties through Finishing Operations—D. H. Powers.

Some of the Newer Textile Fibers Including Glass in the Textile Industry —Rene Bouvet.

At the dinner scheduled for 6 o'clock, S. J. Kennedy, of the Office of the Quartermaster General, U. S. Army, Washington, D. C., will speak, stressing important textile developments of vital significance during World War II and of continuing importance to the armed services.

All concerned with the subject of textile materials or interested in the subject are invited to attend. Dinner reservations with remittances of $3.25 each should be made with E. J. Albert, President, Thwing-Albert Instrument Co., Penn Street and Pulaski Ave., Philadelphia 44, Pa.

• Interchemical Corporation Golf Tournament

The Textile Colors Division of Interchemical Corporation held its annual golf tournament on Saturday, Sept. 6 at Wallkill Country Club, Franklin, N. J. Honors went to James Redmond with a low net of 68 for which he won possession of the Laurence G. Meads Trophy for the year. This is the second time in the history of the tournament that he won possession of the trophy. Low gross went to Jules Devigne with a score of 80. On this particular course there are 6 par 3 holes and the player with the lowest total was S. Y. Stribling, III, with a total of 19. On the second hole, a distance of 130 yds., there was a prize for the drive closest to the pin. This was won by Joseph Barone whose ball was 5 ft. 8 in.

The following were winners in the kickers handicap: Henry Young, S. Y. Stribling, III, Jules Devigne, Norman Cassel, and Jack Scully.

Outstanding event of the day was Max Bender's hole in 1 on hole No. 4, a distance of 205 yards.

• New England Textile Foundation

In July of this year New England Textile Foundation, 68 South Main St., Providence, R. I., successfully completed the first of four campaigns to raise $250,000.00 per year or a total of $1,000,000.00 for the benefit of the four textile schools in New England. It has begun distribution of the funds and as of this date has voted a total of $115,550.00 to be used as follows:—

Recurring Expenditures	
14 sophomore scholarships @ $500.00	$ 7,000.00
25 freshman scholarships @ $500.00	12,500.00
For increasing faculty salaries	27,720.00
	$47,220.00
Non-Recurring Expenditures	
For library volumes and equipment	$14,000.00
For special faculty expenses	3,300.00

• New Home of Spectrochemical Laboratories

The New England Spectrochemical Laboratories have bought and are now occupying the Anna Peabody estate, shown above, on the banks of the Ipswich River in Ipswich, Mass.

The laboratories have greatly expanded their facilities for studying the chemical problems of the modern textile manufacturer. In addition, the laboratories continue to offer all the former spectrographic services, which include the latest special facilities for applying physical methods of analysis to problems of industrial chemistry.

For synthetics equipment ...	5,000.00
For testing laboratory	5,600.00
For new looms	14,630.00
For new chemical laboratory.	10,000.00
For humidifying equipment .	3,000.00
For miscellaneous equipment	12,000.00
	$68,330.00

Most of the scholarships awarded were at Lowell Textile Institute and Textile School of Rhode Island School of Design, because most of the winners expressed a preference for these two institutions. A major portion of the grants voted also went to these schools, because many of the gifts received by the Foundation were earmarked for them and because they have been associated with the Foundation for a much longer time than Bradford Durfee Technical Institute and New Bedford Textile Institute; certain obligations to the first two schools mentioned have been incurred by the Foundation during that time.

It is anticipated that Bradford Durfee Technical Institute and New Bedford Textile Institute will receive increased assistance from the Foundation as time goes on and as the textile mills in the New Bedford and Fall River areas increase their support of the Foundation. The support from these areas in the first campaign was disappointing.

The Foundation reports that additional grants will probably be made to the schools during the current scholastic year, but that in the opinion of the Executive Committee, expenditures from now on should be conservative pending the outcome of the second fund raising campaign.

• Canadian Distribution, Eastman Dyestuffs

Tennessee Eastman Corporation announces that distribution of Eastman Acetate Dyestuffs in Canada will henceforth be handled exclusively by Clough Dyestuff Company, Ltd., 33 St. Mathieu Street, St. Laurent, Quebec. The appointment was made on August 12. Prior to that time, Eastman dyes were sold in Canada through Canadian Kodak Company of Toronto, which had been the sole agent for the past two years.

Clough Dyestuff Company will maintain stocks of Eastman dyes in Montreal to expedite deliveries of all standard types to Canadian dyers. In addition, Clough Dyestuff offers laboratory service, testing, shade matching, etc., and mill demonstrations by their staff.

Sales territories covered by Clough Dyestuff include the Maritime Provinces in the East, the Province of Quebec, Provinces of Ontario and Manitoba, and Vancouver, B. C.

Eastman Acetate Dyestuffs are distributed in the U. S. by the Tennessee Eastman Corporation at Kingsport, Tennessee, and in the Eastern area through the company's warehouse and sales office located at Lodi, New Jersey.

• Division Manager, Heyden Chemical

Dr. Ralph N. Lulek, who has been named manager of the Ammonia Division of the Heyden Chemical Corp. He has been research manager of Heyden since 1946 and is also in charge of the Anti-Biotic Division.

Dr. Lulek is the holder of more than 50 patents in the field of dyes and intermediates and the inventor of several marketed dyestuffs. He was honored as a "modern pioneer" by the National Association of Manufacturers in 1940. He was previously associated with the duPont Company and the Publicker Industries.

He is a member of the American Association of Textile Chemists and Colorists, the American Chemical Society, the American Institute of Chemical Engineers, the Industrial Research Institute and the West Virginia Society of Professional Engineers.

• New Monsanto Plant

Completion of a new $3,000,000 plant at Monsanto, Ill., for the manufacture of Santomerse No. 1, a synthetic detergent with a wide variety of industrial and home uses, was announced recently by Monsanto Chemical Company.

Among the numerous advantages said to be possessed by Santomerse is the ability to function efficiently and economically in water which is hard or soft, hot or cold. It also functions in either acid or alkaline solution and prevents formation of insoluble curds, scum, or rings in hard water.

The product's properties are such that it is said to provide wetting out, dispersing, emulsifying, penetrating, and cleaning actions all in one operation. It is available in two dry forms, bead and flake.

• New Instructors, L. T. I.

President Kenneth R. Fox of the Lowell Textile Institute has announced the appointment of 9 new instructors to the faculty to handle the record enrollment of nearly 600 students, nearly double prewar figures.

Thomas F. Kelley, Jr. of Lowell was appointed instructor in the chemistry department. Mr. Kelley graduated from the Lowell High School in 1943 and received his SB degree in chemistry from M.I.T. in 1946. Since then he has been on the chemical research staff there.

Also appointed instructor in chemistry was Vasilis Lavrakas of Boston. He received his BS in chemistry at Mass. State and an MS from Tufts College. He is a veteran of World War II serving as a First Lieutenant with the U. S. Army. He is presently employed as a chemist by the Hood Rubber Company.

Joseph B. Masaschi of Cohasset also was made an instructor in the chemistry department. He received a BTC degree from the Lowell Textile Institute in 1944, and has done advanced work at M.I.T. and Boston University. Following graduation, he served two years in the Navy as an ensign on a destroyer. At present he is chief chemist with the Commercial Filters Corp.

Clarence J. Pope of Charleston, S. C. was appointed instructor in the cotton department. He received a BS in textile engineering from Clemson College in 1941 and served in the Army infantry from 1941 to 1945, rising to the rank of captain. He saw combat duty in the Pacific area. Since discharge he has been with the quality control section of Textron at Suncook and Manchester, N. H.

Louis W. Stearns of Chelmsford was made an instructor in the department of languages, history and economics. Mr. Stearns received his BS from Tufts College and his MA from Harvard in 1940. From 1940 to 1945 he served in the U. S. Army. At present he is teaching English at Howe high school in Billerica.

Also appointed instructor in the same department was Wallace C. Butterfield of Lowell. He is a graduate of the Lowell High School and the Wharton School of Finance and Commerce at the University of Pennsylvania. He served over four years with the U. S. Army during World War II and since his discharge has been Bursar at the Institute.

Harold G. Buchbinder of Boston was appointed instructor in the engineering department. He has studied at Northeastern University, CCNY, Harvard University and received his BS degree from Cor-

nell in 1945. Since then he has done advanced work at MIT where he served as staff assistant in the Bomb laboratory and Instrumentation laboratory.

James W. Bell of Spokane, Washington was also appointed instructor in engineering. He attended Oregon State College and has taught at Farragut College and Technical Institute. Mr. Bell has had wide industrial experience with precision machine work.

Albert L. Carpentier of Andover was also appointed an engineering instructor. He received his SB degree from M.I.T. in 1940 and, after working as a textile engineer, he entered the Navy, where he served four years as Lt. (SC). Since his discharge he has been assistant plant engineer at the Textron plant at Suncook, New Hampshire.

• Sales of Synthetic Organic Chemicals

In 1945 the sales value of synthetic organic chemicals and their raw materials produced in the United States totaled 2.2 billion dollars, according to a final report recently released by the United States Tariff Commission. The quantities produced (37 billion pounds) and sold (25 billion pounds) were about the same as in 1944. Outstanding among the several groups of items produced were synthetic rubber, coal-tar intermediates, and plastics materials.

The survey for 1945 is the twenty-ninth annual report on the domestic synthetic organic chemical industry issued by the Commission. It gives final statistics on production and sales in 1945 for all synthetic organic chemicals for which preliminary data were published earlier and, in addition, lists the names of the products produced on a commercial scale during that year and the manufacturers of each.

The data are classified into three major divisions—raw materials, intermediates, and finished products.

Copies of the report, *Synthetic Organic Chemicals, United States Production and Sales, 1945.* (Report No. 157, Second Series), may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 45 cents each.

• Standards Listing Available

An entire new listing of its 874 standards is now available free of charge at the American Standards Association and may be obtained from their office, 70 East 45th Street, New York 17, N. Y.

The new listing of American Standards includes prices which are revised slightly upward, because of increased production cost.

• Joins Nuodex

J. C. Robertson, who has joined the sales staff of the the Nuodex Products Co., Inc., Elizabeth F, N. J., chemical manufacturers, to handle sales in the south of the company's line of fungicides and microbicides, according to H. M. Johnson, Vice-President in charge of sales.

Mr. Robertson, who has had over 30 years' varied experience in the textile industry, will be headquartered at 1229 Pasadena Avenue, NE, Atlanta, Ga. and will be responsible initially for selling and servicing the newly developed fungicide Nuodex 100, claimed to be the first mildewproofing agent for product or process which has all the qualities of the ideal textile mildewproofer.

Mr. Robertson was last connected with the Aqua Sec Corporation, New York, for which he handled sales and service in the southern territory. Previously he had been employed by the Beach Soap Company, Lawrence, Mass., selling soaps and soap products to textile mills and also by the DuPont Company's R & H Chemical Division promoting their chemicals to the textile trade throughout the south.

Mr. Robertson was also a chemist and dyer for United Elastic Corp., Littleton, Mass., and The Franklin Process Co., Providence, R. I.

A number of additional revised standards approved since the January 1947 issue of all American Standards are included.

Under the new price listing a complete set of all American Standards comes to $200.00 and a complete set of all American Safety Standards costs $32.50 a set.

Customary quantity discounts are allowed in the new catalogue. These range from 20 percent to 45 percent for various quantities up to 1,000.

• Retires from duPont

Dr. Emmet F. Hitch, special assistant to the management of the Du Pont Company's Chambers Works, Deepwater Point, N. J., retired September 30 after 29 years with the company. He is joining the faculty at Purdue University as professor in the department of chemistry.

Dr. Hitch joined the Du Pont Company in 1918 as research chemist in charge of the Azo Dyes Division, Jackson Laboratory, at the Chambers Works, and remained in that capacity until 1934 when he became assistant director of Jackson Laboratory. In 1937 he became chemical superintendent of the Chambers Works and, in 1944, special assistant to the management of Chambers Works.

In 1944 he received the honorary degree of Doctor of Science from Washington College. Dr. Hitch is a member of the Sigma Xi honor society, Lambda Chi Alpha social fraternity, American Chemical Society, American Institute of Chemical Engineers, and American Association of Textile Chemists and Colorists.

• Hukill Chemical Corp.

Hukill Chemical Corporation has recently been formed as a sales organization in Cleveland, with offices at 4614 Prospect Avenue, Cleveland, Ohio, to handle specialized industrial chemicals and resins.

The Hukill Chemical Corporation is presently engaged in making contacts with producers of specialized industrial chemicals, both inorganic and resinous (organic) desiring representation in Ohio, and surrounding territory. They will soon be able to warehouse stocks for their principals, and are now in a position to consider several more specialized lines requiring distribution in this territory.

• Acquires Spectrophotometer

The Chemistry and Textile Coloring Department of Lowell Textile Institute has just obtained a new model Recording Spectrophotometer. This instrument was invented by Dr. Hardy of the Massachusetts Institute of Technology and is currently being manufactured by the General Electric Company.

There are only about a dozen of these instruments now in commercial use and the acquisition of the instrument by Lowell Textile Institute marks a very decided step forward in its color measurement facilities.

The instrument will be used for instruction of students, the carrying out of advanced research work, and it is also hoped that the textile industry will make use of the instrument for settling disputes as well as research on dyeing and finishing problems.

• PATENT DIGEST •

PAUL WENGRAF

Creaseproofing with methylolmelamine—Quaternary ammonium condensates G, 2, 04

U. S. Pat. 2,420,157
(Am. Cyanamid, West, May 6, 1947; application February 12, 1943)

Melamine - formaldehyde resins have often been proposed for imparting crease resistance to cloth. In recent times many patents have been granted relating to the use of methylolmelamine intended to make fabrics also water repellent. It was necessary here to use organic solvents for impregnating the fabrics whereby serious difficulties are known to occur. The present invention has the purpose of bringing these melamine-formaldehyde condensates or pre-condensates into a water soluble form and to dissociate these complex compounds upon the fiber depositing thereby stable resins for the purpose mentioned above. It has been found that uncured melamine - formaldehyde products (thus also the methylolmelamines, obtained as *precondensates* from melamine and formaldehyde) can be reacted with salts of tertiary nitrogen bases to form water soluble quaternary ammonium salts which have the valuable property of dissociating at temperatures above 80°C; but the examples indicate temperatures of 260-280°F. = about 130-140° C. In an example melamine and formaldehyde are warmed in the proportion one mole to 4 moles until solution occurs. Thereupon the batch is cooled and the methylolmelamine crystallizes out. 25 p. of this product are dissolved in ethanol and heated with pyridine hydrochloride at 30-35° C. By pouring this mixture into acetone the pyridinium salt of tetramethylolmelamine is recovered, being a white, water soluble powder. Cotton cloth is impregnated with a 5 per cent solution of this product and heated at 260° F. By combining the methylolmelamine with higher fatty (for inst. lauryl) alcohols, permanent water repellent fabrics can be produced.

The "Velan" patent, Brit. P. 466,871 (Imp. Chem. Ind.) and the "Zelan" patent, U. S. Pat. 2,216,406, (du Pont), suggest to use for water repellent effects, as well known, aqueous solutions of quaternary ammonium bases for instance octadecyloxymethyl-pyridinium chloride. The impregnation is followed by a "baking" process during which the pyridinium group is split off. A scientific explanation of the "Zelan" type reaction has been offered by Zerner and Pollak in "Textile Research Journal" 1944, p. 242. It has been observed that a product, combined from: stearamide—one (or more) methylene group(s) — pyridinium chloride is linked with the methylene group to the cellulose molecule while the pyridinium complex is removed in the "baking" operation. It could moreover be proved that the number of methylene groups present is decisive for the water repellency. Odd numbers of methylene give favorable, even numbers (2, 4, etc.) poor results. This phenomenon can be theoretically explained by steric reasons. Thus it can be seen that the present method has only some utter resemblance with the "Zelan" process by using pyridinium compounds and baking the impregnated goods. But actually the present method belongs rather to the group of proper resin finishes. Consequently the Patent Office cited amongst others mostly resin finish patents granted to d'Alelio—Gen. Electric such as U. S. Pat. 2,368,451, 2,340,044, 2,339,768 etc., describing the use of melamine resins for finishing purposes. Other references are for instance: U. S. Pat. 2,385,765/6 (Am. Cyanamid) applying fatty acid substituted triazines such as stearo guanamines combined with formaldehyde for obtaining water repellent finishes. Modified methylolmelamine finishes have also been suggested in Brit. P. 581,785 (Heberlein): treating textiles with solutions of methylolmelamine, modified with butanol or Brit. P. 512,089 (Ciba): finishing textiles with stearic acid modified melamine resins.

Screen Printing Apparatus D, 4

Re-Issue 22,835

(Robert F. Foard, Re-issued January 28, 1947; to U. S. Pat. 2,326,290, February 13, 1945)

The screen printing apparatus, protected by this patent, aims at two principal effects which are said to be attained by this invention: (a) the proper registry between succeeding design units and (b) a comparatively inexpensive screen printing equipment, making it possible to print rather complicated, multicolor patterns in small yardages where roller printing is not economically feasible. A perspective view of the apparatus is offered in Fig. 1: the single frames are carried by an elevator cage (2) and placed from there over the cloth to be printed. Two drums (12) and (13) mounted beneath the printing table have to carry a backing sheet (14), *preferably made from strong (wrapping) paper.* This sheet is used for feeding the cloth. Normally the printing paste by itself is sufficient to stick the cloth to the backing sheet. The most important part of the invention which can only briefly be explained has to be seen in the mechanism driving the backing sheet to which the cloth adheres. A speed control apparatus is provided, illustrated in Fig. 3, 5 and 6. The shaft (35) is driven by an electromotor (34). The forward gear (38) is connected with a pawl (40) so that the pulley (33) rotates at the same speed running in the same direction with shaft (35) but moves at a slower speed when the motor is reversed. This automatic slowing down of the speed of the drums (12) and (13) is initiated by a contact roller (51)—see also Fig. 2—riding on the edge of the sheet (14). Slots (52) are accurately placed in certain intervals to slow down and later on to stop completely the movement of the supporting sheet. During this stop the proper screen printing operation is performed as usual. A modified form of

Screen Printing Apparatus

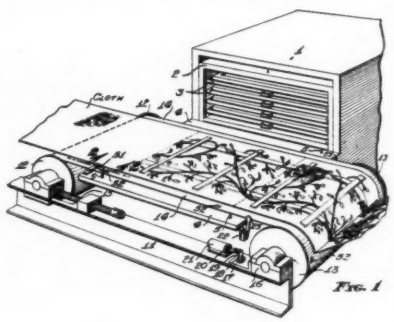


FIG. 1

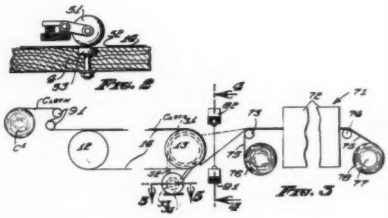


FIG. 2

FIG. 3

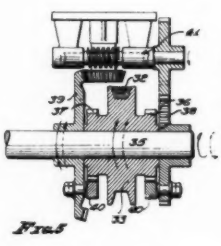


FIG. 5

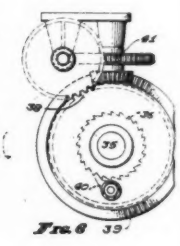


FIG. 6

the apparatus permits of making two or more prints in different colors at the same time. Because of the small extensibility of the backing materials, consisting of rigid wrapping paper or the like, the position of the screens and the stopping of the running sheet is always performed at exactly the same place. Care is taken for keeping automatically the backing from sliding sidewise during the printing operation.

Reference: French Pat. 763,789 (Badoy) describes a screen printing apparatus using a transport sheet which is carried by two rotating drums instead of the usual table construction. The movement of these drums is automatically stopped on the proper places for starting the printing operation.

Dyeing Nylon—Using acid Chrome Colors C, 4, 07

U. S. Pat. 2,421,131

(Geigy Comp., Skeuse, May 27, 1947; application June 11, 1945)

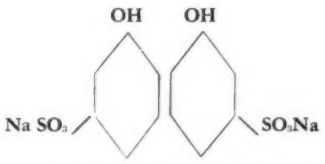
Nylon fibers are generally dyed with acetate colors. Other dyestuffs have been proposed, (also chrome dyestuffs) but the results were not satisfactory. The inventor observed that chrome colors can be fully developed by using a new method. It has first been stated that chrome colors do not stand severe soaping and washing tests unless they are *fully developed* upon the fiber. This full development, having the effect of producing very uniform and washfast shades, consists of dyeing first the nylon fiber with the chrome color in a strongly acid bath, thereupon afterchroming the dyeing with potassium or sodium dichromate and finally treating it with steam at a pressure of 8 lbs. at 235° F., and soaping and rinsing it as usual. Dyestuffs mentioned in the examples are Eriochromoflavine A and Eriochrom Red B. The Patent Office cited as reference an article, contained in "Textile Colorist," Vol. 62, No. 742, p. 696 (Noble), stating that only the afterchroming method can be applied to chrome dyestuffs in dyeing nylon. Rayon Textile Monthly, Jan. 1947, p. 75 (Chocquette) discussed recently the behavior of different dyestuff groups (among others also of chrome dyes) in dyeing nylon fibers.

Reproducing Prints by azo dye formation, using electric current D, 1

U. S. Pat. 2,421,367

(Radio Corp. of America, Solomon, May 27, 1947; application October 24, 1942)

The patent relates to a new method for producing azo dyes *in situ* from mixtures of a sulfonated diazotizable aromatic amine, of a nitrite and a coupling component. By local electric impulses the areas are subjected to currents of different strength and as a rule the amount of dye deposited corresponds to the strength of current caused to flow through the recording paper cloth or similar material, carrying the patterns. With respect to increasing tendencies of decorating sheets by photographic sensitizing methods this invention might be described here with some details although the main field of application seems to be the production of full or half-tone shades, decorating effects on paper or the reproduction of documents and the like. The formation of dyestuffs by the action of electric current on mixtures as described above is generally known as stated in the following references but the innovation, reported in this specification consists of using *sulfonic acids of aromatic amines* instead of aromatic amines themselves. Examples are metanilic acid, sulfanilic acid, etc. as the amino components and for instance chromotropic acid salt



= 1-8-dioxy-2-6-disulfonic acid as a coupling agent.

Reference: Dyeing in an electrostatic field has been described in U. S. Pat. 2,366,347 (Am. Cyanamid): the effect has to be seen therein that fibers are swollen and the concentrated dye liquor is caused to migrate within the fibers.

References cited by the Patent Office are among others: The specification mentions the U. S. Pat. 2,306,471 (Radio Corp. of Am.) proposing to produce a picture by using the action of an electric current on a composition of an aromatic amine salt, a coupling component, nitrite and another salt. The diazotization's reaction starts with the electrolyzing reaction and forms the insoluble azodyestuff *in situ.* An example is a toluidine salt, a dioxynaphthalene sulfonate as a coupling agent, nitrite (for diazotizing), alkali (for neutralization) and NaCl (as an electrolyte). U. S. Pat. 2,173,141 (Radio Inventions) protects the manufacture of an electrolytic recording paper, containing an electrolyte (K Cl) and a sparingly soluble antimony salt, for instance antimony oxy chloride ($Sb_4O_5Cl_2$). By contacting this sheet with a stylus, metallic marks appear in the coated paper (and not on the electrode as it might occur when soluble antimony salts are used).

The idea of producing mixed azo dyestuffs by applying a mixture of diazoaminosulfonates, nitric and coupling components has been used as well known in the textile industry. The "Rapidazoles" (compare for instance Brit. P. 377,207) are typical examples for these compositions.

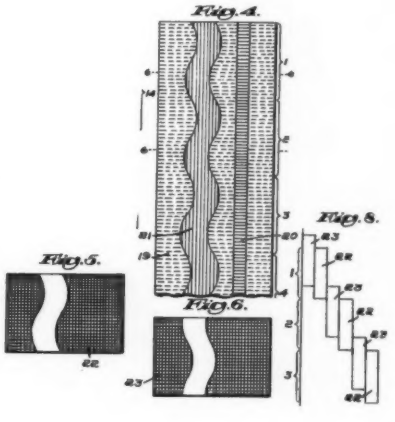
Screen Printing Method — Preventing juncture marking D, 4

U. S. Pat. 2,421,410

(Goodall-Sanford, Inc., Bucklin, June 3, 1947)

Great difficulty has always been experienced by the appearance of marks, resulting from a defective juncture of two adjacent screens. This imperfection shows up particularly when the color of the background has to extend continuously between adjacent repeats. This fault is termed in the present specification as "juncture marking." The solution of the problem to eliminate juncture marking consists thereof that for each color *two screens* are manufactured *instead of a single screen.* These two screens are applied in such a way that the front end of one screen overlapping a part of the other screen, having otherwise the same pattern as the first one, covers free spaces which might result from an imperfect fitting of the adjacent screens, placed one besides the other. Of course complete blending of the colors, used in brushing on the two screens is required. A simple pattern is illustrated in Fig. 4, having a sinuous (21) and a straight (20) stripe. The sinuous stripe is produced here by combining two screens Fig. 5 (screen 22) and Fig. 6 (screen 23). A schematic explanation of the working method by superposing alternatively screens (22) and (23) is given in Fig. 8.

Screen Printing Method



ABSTRACTS
FROM CONTEMPORARY JOURNALS

Dyeing, Printing and Finishing in Relation to Fabric Construction

R. S. Greenwood and C. P. Atkinson, Journal of the Society of Dyers and Colourists, page 208, Vol. 63, No. 7, July, 1947.

This article opens with a discussion of the fibers of which the cloth is composed, the effect of yarn crimp, turns in yarn, weave, the effect of method of spinning and its relation to filament length and filament denier in spun rayons, fabrics with scaffolding threads and fabrics for raising, all in relation to dyeing and finishing.

Finished fabrics are divided into three groups. *Group I*—Dyeing and finishing are subordinate to cloth design and construction and includes the majority of dress, lingerie and furnishing fabrics, which rely on yarn content and surface structure for their appeal; almost all crepes as well as rayon mixture fabrics are included. The aim of the dyer in handling this group is to develop and then maintain the inherent characteristics. *Group II*—The fabrics are the result of cooperation between the designer, the manufacturer and the finisher and are composed mainly of cotton and wool and include cotton fabrics with a raised finish, those produced for a Schreiner finish, rayon in staple form mixed with wool to produce special effects. *Group III*—The majority of textile fabrics belong to this group, their finished state not differing fundamentally from their loom state and being dependent on the skill of the finisher rather than on cloth construction. Rayon fabrics are given pressed, embossed, moiré and ciré finishes; cotton finishing processes include mercerization, filling, back filling, calendaring, compression shrinkage, etc.; wool finishing includes London shrinking and chlorination; the crease-resist process is an example of a finishing process for spun rayon.

As regards printing, the construction of a fabric obviously bears some relationship to the finished result and preparatory processes have to be modified according to the type of yarn used and build of cloth.

Shrinkage treatment varies with each fabric construction.

A number of specific examples are given throughout the paper and the author calls for increased cooperation and exchange of information between all units of textile production to achieve the best results.

Use of Alkali in Loose Wool Processing

N. W. Gillam, The Textile Journal of Australia, page 87, Vol. XXII, No. 2, April 21, 1947.

Consideration has been given in this paper to the possibility of conserving alkalies in the normal methods of processing used for loose wool. Recommendations are given for raw wool scouring and neutralization after scouring. It is pointed out that definite recommendations are difficult to make since the operations are part of a continuous process, and the conditions of the various solutions can gradually change with use. Also, the types of wool and the purpose for which the wool is to be used would have to be considered.

Post-war Developments in the Processing of Flax

Flaxman. Textile Mercury and Argus, page 951, Vol. CXVI, No. 3039, July 4, 1947.

Fiber quality is closely related to methods of crop production and correct timing of harvesting operations but it is very largely determined by efficient handling and proper control of the retting and scutching processes in which development has been most marked in recent years.

The advantages of tank retting include definite control of conditions which can be regulated to suit the particular requirements of the straw, and a considerable reduction in the time required for this process. Soft water gives best results in the shortest time. Increasing the temperature of the ret liquid speeds up bacterial development and the rate of retting, but more active control is necessary.

Under proper control artificial drying can be effected without adverse reaction on the fiber quality.

There is a short discussion of scutching equipment.

Use of Enzymes in Production of Shrink-Resistant Wool Fabrics

Christopher S. Jones, Textile Age, page 52, Vol. 11, No. 8, August, 1947.

The use of proteolytic enzymes is suggested for making wool non-shrinkable. The new treatment is said to be particularly suited for the treatment of wool when mixed with cellulosic fibers, inasmuch as it has no action on the latter.

To make the treatment of wool with enzymes commercially possible it is necessary to devise methods of accelerating their action on wool. The resistance of wool to enzyme action is probably due to the compact nature of the wool keratin arising mainly from bridging of the polypeptide chains by relatively short cystine disulfide cross-linkages.

The use of papain is discussed. At 65° C. a 0.025% papain solution in 1.0% sodium bisulfite solution has been found to convert wool into a mass of cortical cells in 17 hours. The scales of the wool are more readily attacked than are the cortical cells.

Uniform penetration of the enzyme solution will be necessary and the use of a wetting agent to facilitate penetration and dispersing agents to increase the uniformity of absorption are suggested.

The handle of enzyme-treated wool is soft and over treatment does not cause it to become harsh. Enzyme-treated wool is less wettable than ordinary scoured wool.

In mixtures of silk and wool the bisulfite-papain solutions can be used to degum the silk and make the wool nonfelting in the same operation.

Textile Finishes from the Consumers' Point of View

A. M. Mehta, The Indian Textile Journal, page 735, Vol. LVII, No. 680, May, 1947.

The use of various finishes are discussed from the point of view of the average consumers' demands which are summarized as follows:

1. Long life and ability to take hard wear.
2. Maximum style and beauty for luxurious and smart trim effects.
3. Ease of handling.
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5. Ventilation for dissipation of body interior heat.
6. Maximum resistance to ravages of accumulated road dust and dirt.

Wool Dyeing Assistants

S. Yates, Textile Recorder, page 55, Vol. LXV, No. 771, June, 1947.

The primary consideration in any dyehouse is the water supply. A number of processes for water treatment are discussed, including the following: soda-lime process, zeolite water softeners, base-exchange resin water-softening compounds, Calgon and lime-soap dispersing agents

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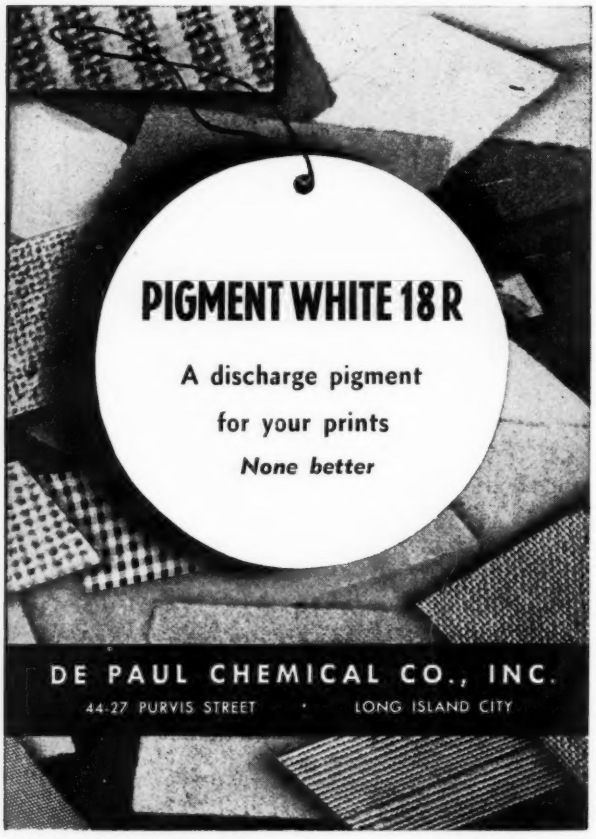
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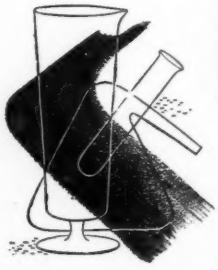

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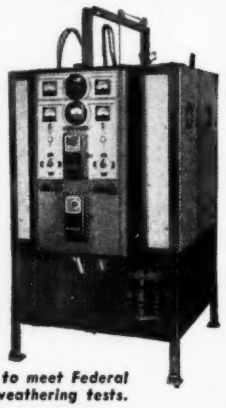

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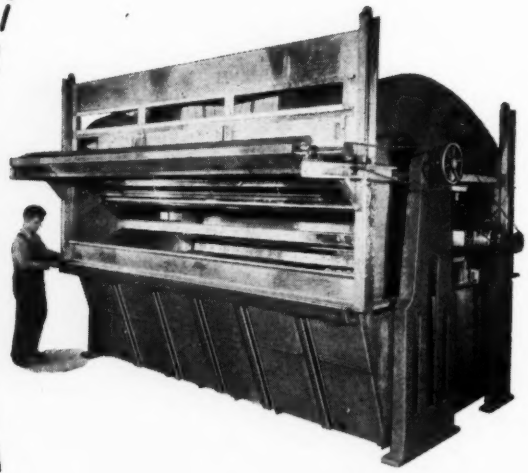

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POSITION WANTED: Ten years of lab experience with leading dyestuff and chemical manufacturer. Five years of practical dyehouse and lab experience on rayon skeins and cakes. Desire opportunity as technical representative with manufacturer of dyes and chemicals. Age 35. Letter of interest brings resumé. Write Box 304.

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POSITION WANTED: Chief Chemist, analytical research and textile development expert. Married, with family, currently employed in responsible position by a large textile specialty manufacturer. Have acquired the ability to set up and maintain a complete program for testing and development work in the 10 years' laboratory work with this firm but desire connection with progressive company offering greater opportunities. East Coast preferred. Write Box 311.

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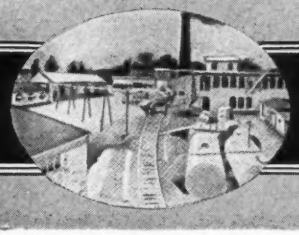

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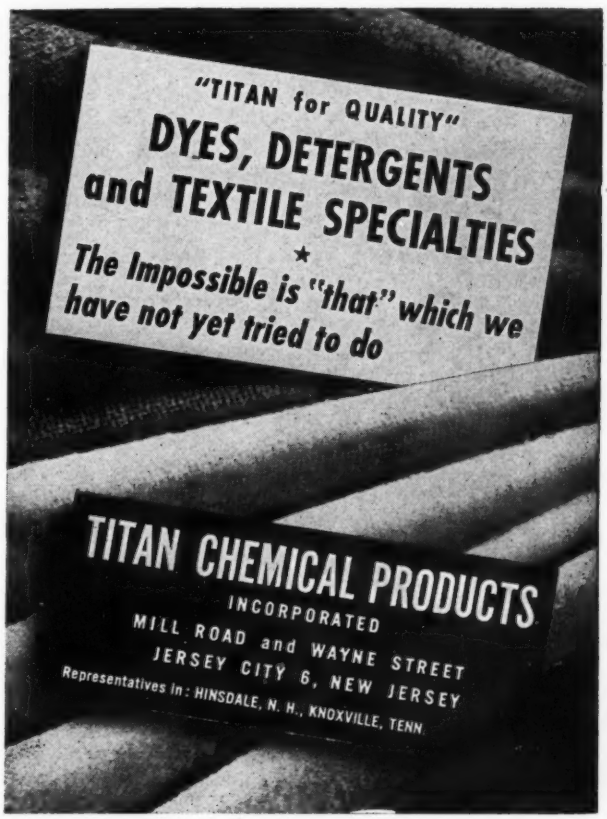
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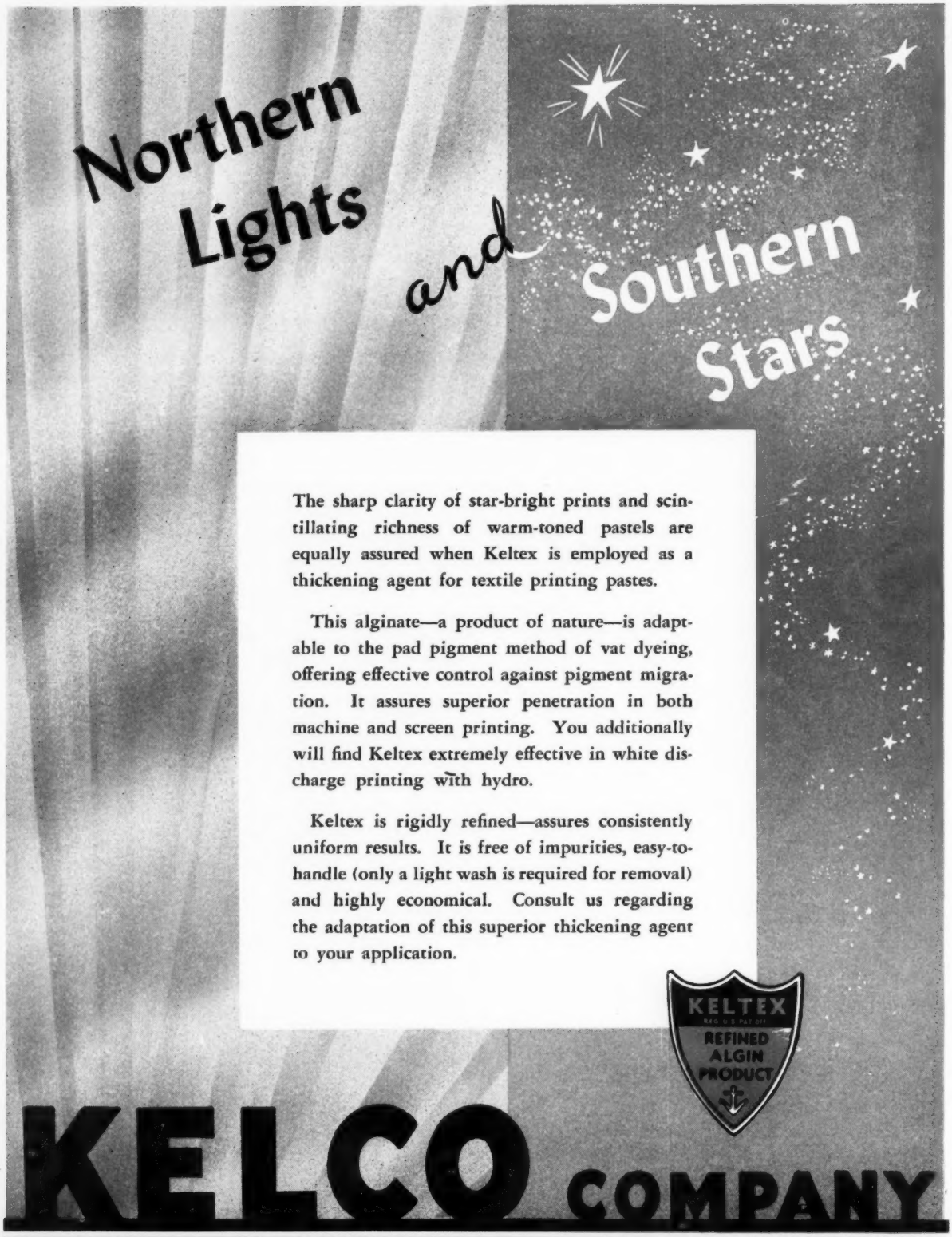

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